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The Canadian Engineer

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The Canadian Engineer.

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THE MANUFACTURER, THE CONTRACTOR AND THE
MERCHANT IN THE METAL TRADES.

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For The Canadian Engineer.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

Chapter VI.

(Continued from last issue.)

RAILWAY LAW.

Railroads being recognized as public necessities have had great powers conferred on them by legislatures, which have also necessitated many legal restrictions to prevent the abuse of these powers. All of which in Canada has in time become formulated in the "Railway Act." This Act defines, amongst other things necessary for a railway engineer to be familiar with:—

I. The powers conferred on the Railway Committee of the Privy Council for negotiating traffic, tolls, returns, methods of operation, of construction, capital stock, and distribution of gross revenue obtained.

II. The privileges and powers granted to railway companies.

III. The duties of a railway company to the Government and to the Privy Council.

IV. The duties of the railway company to the individual, and the rights of the private individual.

Much of the matter contained is rarely needed by the engineer, and the following extracts cover the main information which he is likely to need in the course of construction and maintenance.

I.—Powers Conferred on the Railway Committee.

(*a*) To regulate the speed through various classes of cities, towns and villages—which is not to exceed six miles per hour in any case.

(*b*) To regulate the use of steam whistles in towns, cities, etc.

(*c*) To regulate the means for passing from one car to another, for the safety of employees, and the methods of coupling cars.

(*d*) To impose fines for offences under these clauses.

(*e*) To enquire into, hear and determine applications, disputes or complaints regarding right of way and location questions, constructing branch lines, the crossing of one railway company's tracks by those of another railway company, the construction of railways along or across highways or navigable waters, tolls, rates, running powers, traffic arrangements, unjust preferences, discontinuations, distortions and the carrying of highways, streets, ditches, sewers, etc., over or across the lands of a railway company.

(*f*) By itself or agents, it has full legal power to enter on to property of a railway company to examine books, plans, etc., to summon witnesses and in general it is to have the same powers as a law court.

(*g*) The inspecting engineers of the Privy Council are to have every desired information, in reason, supplied to them on demand. They are to be carried free while on inspection trips, and to have the services of all company telegraph operators free while on Government business—penalties for obstructions of the inspecting engineers are also defined.

II.—The Privileges and Powers of a Railway Company.

These are given with the view of assisting the company in overcoming obstructive measures, of a corporation or individual, where it is evident that the public would be best served by the construction and operation of a railway.

These powers should be thoroughly considered by a company's engineer before taking any steps likely to incur the ill-will of the public, to whom the company must ultimately look for its income.

(*a*) The company or its agent may enter on crown lands or the lands of any person or corporation whatever for the purpose of survey and location.

(*b*) It may purchase land for the use of the railway, and may sell what it does not need.

(*c*) It may build anywhere within one mile of the first located filed line, or within any further distance prescribed by the special Act.

(In the Act a railway is said to be near to another when some part of one is within one mile of some part of the other railway.)

(*d*) It may fell trees within 99 feet of either side of the railway, when they are liable to fall across the track.

(*e*) It may cross or join any other railway, and enter on its lands.

(*f*) It may divert temporarily or permanently streams, highways, water or gas pipes, sewers, drains or telegraph or telephone poles, but must restore them to their former state, if possible, or put them in a state not materially altering their usefulness. (Note this with reference to keeping them open during the construction of the roadbed.)

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* This series of papers will be issued in book form as soon as they have appeared in The Canadian Engineer.

(*g*) It may construct, operate and keep in repair its road, together with the accessories commonly belonging to a railway, and may carry traffic and collect tolls, and may, in general, do everything necessary to a successful operation of its enterprise and the accommodation of the public, but in the exercise of these or other powers the company shall do as little damage as possible, and make full compensation for damage done or loss inflicted, in a manner prescribed in the Railway or a special Act.

The essence of these general powers is compensation. It is the limitation of what would otherwise be absolute, arbitrary powers.

II. (*A*) Powers with Limitations.

(*a*) No person who holds a contract for work with a railway company can be a director on its board, nor can a director or officer of a company even go surety for a contractor.

(*b*) The first charges on the income of a railway company are the penalties, if any, arising from this Act. The next are the working expenses of the road, and the third are the bonds—the latter, however, all having equal claims in proportion to remaining assets.

(*c*) The consent of the Governors-in-Council is necessary before Crown or Indian lands can be entered on, and in the case of Crown lands the right of way only, i.e., an easement, is all that can be obtained, and not ownership or full possession.

(*d*) The consent and approval of the Railway Committee must be obtained before possession or use of the land or property of another railway company can be effected.

(*e*) The ordinary amount of land obtainable without the consent of the owner is 99 feet, while exceptions are authorized by the Minister in case of deep cuts or fills and depot grounds, which is in general limited to a tract of land 1,950 feet long by 300 feet wide, but any extent of land may be purchased with the consent of the owner. Extra land is to be shown on the maps or plans filed with the Government.

(*f*) After filing plans (to be afterwards explained) the company may take possession as shown on those plans, and settle afterwards, amicably or by arbitration. This is a very necessary power, for otherwise contractors would be kept off the land for indefinite periods, the progress of the work impeded and a good chance given the contractors for suits for damages caused by delay, or for excuses for slow progress.

(*g*) The company may enter on lands not more than 600 feet from the located line, for purposes of construction or repairs, without consent of the owner, provided a sum of money, fixed by a judge of the Superior Court, is deposited with that court, pending the award for damages.

(*h*) Power of surveying and arbitrating in the usual way is also given whenever the company desire extra land for stone, gravel, water or earth, or on which to construct sidings or branches, or on which to convey water to the company's works.

(*i*) The company may occupy land between 1st November and 1st April, with snow fences, subject always to damages as a court may decide.

(*j*) No lateral deviation of more than one mile shall be made from the original location, except under provisions of a special Act.

(*k*) Error in name or omission of the same from plans and books of reference does not prevent the company from entering on land so affected.

III. DUTIES OF A RAILWAY COMPANY TO THE GOVERNMENT.

(*a*) On completion of location surveys, plans and books of reference showing all properties asked for, must be forwarded in triplicate to the Minister, who after ten days' notice to all interested parties, hears all counter claims and representations, and the plans, as finally decided on, are signed by the Minister, after which one copy is retained at the department, another is deposited by the company in the office of each municipality affected, while a third one is given into the hands of the company itself. After these proceedings following the action as described in Art. *f*, powers with limitations.

(*b*) All extra widths desired must be shown on the plans filed.

(*c*) Any change from the original plans or profiles must have separate plans, etc., submitted and deposited in the usual way before the alteration can be made.

(*d*) Ten days after plans have been filed in the offices of the municipalities (registry offices) and notice published in a newspaper, a notice may be served on interested parties owning land, giving

(*a*) Description of land required.

(*b*) Amount offered by the company for land or damages.

(*c*) Name of company's arbitrator if offer is not accepted.

Such notice to be accompanied by a sworn statement of a surveyor or engineer (not an arbitrator).

(*a*) That the land is needed as described for the purposes of the railway.

(*b*) That he knows the land, or damages likely to result, from the railway being built and operated.

(*c*) That the sum offered is, in his opinion, fair compensation.

(*e*) Should the offer not be accepted, arbitration is resorted to. This is usually outside the province of the engineer, except in giving evidence and preparing plans, but it may be useful to remember that, in considering the value of land taken or amount of damages done, the increase of values of lands adjacent (*i. e.*, of same plot) not taken by the company, which is created by the construction of the railway, is to be taken into account and offset against damage inflicted.

(*f*) Before a company can unite with or cross over any railway with its roadbed or track, it must submit plans and full details of proposed mode of crossing to the Railway Committee, and give ten days' notice of application to the other company affected. The committee may make such changes or regulations as appear necessary for public safety, and apportion the cost of constructing the necessary works to the different companies, and may also, in case of level crossings, on application of either company, direct such inter-locking signal system or device to be used as, in their opinion, renders it safe for engines to pass over such crossing without coming to a full stop. This clause also applies to electric and other street railways.

(*g*) When the railway is finished, plans and profiles in triplicate of the completed work, showing land taken, names of owners, etc., must be filed as in the original survey or alterations within six months after completion of railway, under penalty of $200 fine per month.

(*h*) The scales of plans and profiles are to be as prescribed by the Minister; they are usually: Plans, 400 feet to one inch; profiles, 400 feet to one inch horizontal; profiles, 20 feet to one inch vertical, and are to be all signed by the chief engineer or president of the railway.

(*i*) Within 48 hours at furthest, after any accident has occurred on a railway line, involving personal injury, or the damage or destruction of any structure, the railway company must notify the Minister of the same under $200 per day penalty. And, if necessary, the Privy Council may appoint a commissioner to enquire into the causes, etc.; of the same.

(*j*) Annual returns from 1st July to 1st July must be forwarded in duplicate to the Minister within three months after the expiration of such financial year by each railway company, of its capital, traffic, working expenditure, and any other information shown on the blank forms furnished.

(*k*) Weekly returns of traffic shall also be furnished the Government within one month after the period quoted, and a copy of the same must be posted for public view in the head office of the company.

(*l*) Twice a year accidents and casualties must be similarly reported within one month after each six months' period has elapsed, giving, (1) Causes and natures, (2) locality and time of day, (3) extent and particulars.

IV. GENERAL DUTIES OF A RAILWAY COMPANY TO THE PEOPLE AND THE RIGHTS OF INDIVIDUALS.

(*a*) A company may not obstruct the entrance to a mine, open or about to be opened.

(*b*) A company shall not impede navigation in a navigable river.

(*c*) In constructing drawbridges, bridge-piers or wharves, the manner of construction as it affects navigable waters shall be fully and entirely decided upon and directed by the Railway Committee, under heavy penalties for disobedience.

(*d*) Highway crossings.

I. A railway shall not be carried along a highway, but shall merely cross it, unless permission has been obtained from the Railway Committee, and, in crossing a highway, a good safe passage for vehicles must be kept open continually and no obstruction offered to travel.

II. In a level crossing, the surface of the rail must not be more than one inch above or below the general surface of the crossing.

III. When a highway passes under a railway, it must have at least 20 feet clear width and 12 feet clear height, and the gradient of the highway shall not exceed one in twenty, unless originally greater and left undisturbed.

IV. When a highway passes over a railway, the approaches shall not have a gradient of more than one in twenty, and must be fenced at least four feet high, and the bridges by which these highways are carried over the railway shall have a clear height of seven feet above the highest freight car hauled over the road, and over 14 feet clear width shall be given on approaches and bridges.

V. The company shall present to the Railway Committee (which notifies the municipality interested that they may oppose by a delegation) a plan and profile of every proposed highway crossing, and the committee will then decide whether it is to be changed in any way, or if a level crossing is approved of, whether a gate and watchmen are necessary to public safety, and the decision of the committee regarding details of construction, and also as to apportionment of costs between the company and other parties interested, is to be final, and followed out within a prescribed time under penalty.

VI. Sign-boards with letters six inches high shall be placed at every highway level crossing.

(*e*) Farm crossings.

One, at least, shall be made for every separate portion of land and for each disconnected portion thereof, so located as to be difficult of access otherwise than by means of a crossing of the railway.

(*f*) Bridges and tunnels.

Shall be built, maintained (and raised if necessary, whenever repaired or reconstructed), so as to maintain a clear height of seven feet between the top of the highest freight car used and lowest beam or obstruction of the bridge or tunnel.

N. B.—The Governor-in-Council may except from this clause any railway on which air brakes are used exclusively. No company shall run cars over any bridge unless constructed and maintained with safeguards, and of strength approved of by the Minister.

(*g*) Fences and cattle-guards.

Whenever municipalities are surveyed or settlement exists, fences and cattle-guards shall be built and maintained, and in case of adjacent land being occupied, this must be done as fast as rails are laid, and the company shall provide gates having proper fastenings or hurdles at all farm crossings. When this is done, it is the duty of the landowner to keep the gates closed when not in use. If left open accidentally, no action for damages against the company can be sustained, and if left open purposely, a counter-claim for damage may be entered in addition to inability of recovering for loss of animals, etc., resulting from such leaving open of gates, etc. (Fences must be turned in to the cattle-guards).

(*h*) Opening of the railway for traffic.

No company shall open its road for passenger traffic until one month after giving notice in writing to the Minister, and after an inspecting engineer sent by the Government shall have reported favorably as to the safety of the road, strength of structures, and adequacy of rolling stock.

(*i*) Repairs.

Upon complaint of the officers of any municipality, the Government shall send an inspecting engineer to examine the condition of the road, and the company shall at once make such repairs as he considers necessary for public safety. Until such repairs are made the engineer may limit the number, speed or weight of trains and engines passing the point under repair.

(*j*) No discrimination in tolls between different persons or companies for the same service shall be allowed; any special rate allowed to one must be allowed to all.

(*k*) No secret special rebate or toll shall be allowed, and any company shall on demand make known to any one any special rate, toll or rebate.

(*l*) No discrimination between places shall be allowed, unless a lesser rate is necessary to secure freight at a competing point. (This, therefore, protects local points only against one another, and not against railway centres.)

(*m*) Every company shall afford full and equal advantages to all persons wishing to ship or travel over their railway, and shall afford equal facilities to each and every connecting line or lines of railway for transfer of traffic.

(*n*) Every company affording facilities to any express company shall grant the same to any other express company demanding it.

(*o*) Every agent of the company shall receive freight or any allowable traffic when offered for shipment, under penalty.

(*p*) Every train before crossing a draw or swing bridge shall stop at least one minute to ascertain from the bridge tender that the bridge is closed and safe to cross.

(*q*) At least 80 rods before crossing every highway (on level) a bell must be rung or whistle sounded, and this must be continued at short intervals until the crossing is passed.

(*r*) An officer shall be stationed at every level crossing of two railways, and no train shall pass over it until a signal has been made to the conductor that the way is clear.

(*s*) Every train shall stop one minute at a level railway crossing as in No. 16, unless there is an interlocking system, when they may pass at such speed as the committee may allow.

(*t*) No train shall pass through thickly populated towns, etc., at more than six miles per hour, unless the track is fenced.

(*u*) No train or car shall be allowed to stand on a highway crossing more than five minutes at a time.

(*v*) All frogs, wing rails, guard rails, etc., shall be packed up to the underside of the rail wherever less than five inches space exists.

(*w*) Sections (*p*), (*r*) and (*s*) have been recently modified so as to permit of interlocking signals being introduced at junctions and railway crossings, in which case the Privy Council may permit trains to pass in or across at specified rates of speed without stopping, whenever the signals give the right to do so, but if the signals are not satisfactorily worked the council may revoke the permission.

For The Canadian Engineer.

THE VENTILATION OF PLUMBING APPLIANCES.

BY W. M. WATSON.

In a former article I showed some of the evils attached to the present method of ventilating traps at the highest points, and the danger of venting plumbing in any case. I have never been able to find out the reason why such a complicated and expensive system was invented, but have an impression that the inventor erroneously thought that there would always be an upward current from the breather pipe at the ground line to the terminating end of the soil pipe above the roof, and there certainly would be if the temperature of the atmosphere at both points were always equal, or if it were always colder above the roof than it is at the mouth of the breather near the ground line. But sometimes it is warmer, and in that case there will be a down in place of an up draught. If the purification of the interior of the house soil pipes was aimed at, then the object is often frustrated by the choking of the street line sewer trap, or by the breather getting filled with stones, dirt, or weeds, and even when every point of the house drainage is free, open, and working well, we find that by adopting the Chicago and Toronto rules we are sacrificing the greatest sanitary privilege adopted, viz., the ventilating of the street sewers above the house tops, for the insignificant purpose of securing a very small and doubtful advantage.

When the soil pipe is connected without the street line trap, direct to the crown of the main sewer, as shown in The Canadian Engineer of April, 1897, there is nearly always an upward current from the drain to the head of the S.P., because the temperature in the main sewer will generally be higher than the atmosphere, and if any exception to the rule occurred, causing a down draught, the foul odor in the house soil pipes would be forced into sewer, instead of out of the breather, which is the case at present. Since the American system of plumbing was adopted in Toronto I have noticed some of the places where fever and diphtheria have occurred, and I believe that statistics will bear me out when I say that the street line trap and vent-pipe method of plumbing is doing considerable damage. It is hard to choose between the evils of the careless putty and paint plumbing of twenty years ago and the intricate plumbing demanded at the present time in Toronto.

When Dr. Norman Allen was the medical officer of Toronto I asked him if he considered it right to spoil the ventilation of the public sewers and injure private property by compelling each owner to put in a trap at the street line of the private drain? His answer was, "No," but he reminded me that the by-law was passed by the council, and again altered within a few months, and that if another change was made so soon it would put both his department and the council at a disadvantage, because the public would get alarmed and lose confidence. The fact that the present officers who apply the law in Toronto are in no hurry to give their own private property the benefit of the Toronto plumbing by-law, proves that we might place them also as unbelievers in the system.

It is necessary to keep polluted air moving, and the vent pipes will help to do this; but to get air to circulate naturally, it must have a continuous circuit, and if branches are inserted into the line, the draughts will be spoiled, exactly as with the draught of a stove, when the smoke pipe is inserted into a chimney flue where there is another stovepipe hole open. Taking this fact into consideration, it shows that as every house must have at least three vent pipes, and two of them are branched into one, or all three are branched into a receiver, which in turn is branched into the side of the soil pipe, it makes it impossible to secure a natural draught through any of the pipes, because no continuous circuit can be formed, and the conclusion must be that the only real value the vent pipes can be, is, that they do away with any pockets where air may lodge in the waste pipes, and will prevent any chance of syphoning of the traps.

There is evidently a strong feeling in certain quarters in favor of creating unnecessary business, increasing expenses, and securing a monopoly in favor of syndicates and wealthy tradesmen, to the exclusion of the small ones. When reading the by-laws of Toronto one cannot but see that the sanitary advantages are put in the shade by the points that call for high licenses, heavy bondsmen, useless piping, labor and joints. Great waste is obvious in many places. In one case we find a sink only intended to catch water from a garden tap placed in the cellar that has about 40 ft. of 1½ in. iron vent pipe running level under the ceiling joists until it is attached to the w.c. vent. Now the friction that will have to be overcome before any movement of air can take place in a 40 ft. length of so small a pipe laid horizontally, is more than enough to totally prevent any action, and of course such a pipe is perfectly useless. In some small cottages rented for about $4 per month, having a w.c. and soil pipe through the roof, and on the opposite side of the house a sink with about two feet of 1½ waste pipe and trap attached to a properly ventilated drain, as also a vent pipe taken from the knee of the trap and continued up to above the roof, with 3 in. iron soil-pipe, costing about $14 each house, which expenditure is of no value for sanitation purposes, and it injures the current of air in the drain, and assists to dry out the sink trap.

There are a number of large towns, with a dense population closely packed together, in Europe, whose sanitary rules are of such a nature, and so well applied, that with all the disadvantages of the majority of the people working in close, heated rooms, having the fumes from grease, soap, steam, etc., to inhale, the death rate is less than either Toronto or Chicago. The mode of application of their sanitary rules is both simple and effective. Before property can have the privilege of water supply, the waterworks' rules must first be complied with; also before it can secure the advantage of a sewage outlet to the street sewer, the health and sanitary laws must be fully carried out, and if property is not supplied by these necessary requirements it cannot be inhabited. But no public body can interfere with the rights that have already been acquired, except by paying compensation, unless the property is or contains a public nuisance and is unfit for public habitation, and even in that case the courts of law are not often required, for if an owner declines to keep his sanitary and waterworks appliances in good order he will receive notice to have them corrected, and when the time given expires, and the request is not complied with, the public authorities send their own tradesmen to do the necessary repairs, and charge the cost in the tax bills. This can all be done without threatening letters or a dozen visits from inspectors, and at a cost of about one-tenth of what it cost Toronto, and also without dragging the respectable citizens and tradesmen into a criminal court, or scaring weak people with official letters. When engineers and inspectors are clothed with absolute authority, those tradesmen who are compelled to work under them might almost as well hand their business over to the fortunate official, or make special efforts to please him in some other way, for there can be a wide difference between an inspector being satisfied with the work done at two different places, and by two different firms. I have had a letter in my possession from a former engineer of Toronto, in answer to a plumber's complaint about an official who had been unreasonable, and demanded more than the law required, which stated that the inspector could not be wrong, and he must be obeyed or a summons would be issued. The complainant then applied to the mayor, and the council appointed a committee which never met or gave the plumber a hearing. This sort of management usually occurs where business is done in favor of or by the requests of syndicates and monopolists that have a strong financial backing.

All rules and regulations made for the government of the general public should be plain, clearly described, easy to understand and carry out in every detail, definite and pointed, and having illustrated diagrams and plans showing what is wanted. It is unfair and unjust to allow any single person or body of officials to have the power to harass a tradesman, so that his expenses are increased and business damaged, while another friendly business firm may evade the law, or its work be easily declared satisfactory, securing good profits. The best sanitary laws are so framed that the most ignorant mechanic cannot make an error or mistake that will in any way injure the public health, and every detail of the fitting inside the building can be observed at a glance.

For The Canadian Engineer.

FOUNDATIONS.

BY CHARLES BAILLAIRGE.

Allow me through the medium of your journal to call the attention of Canadian architects to the very concise and lucid illustrated article on "Foundations," which appeared in your last issue. The writer says: "The foundation of a structure is much more important than any other feature of its design, as on its security depends that of the structure itself." Our Canadian architects, I am loath to say, have not of late years been up to the mark in respect to foundations. Hence so many failures of buildings, especially of country or parish churches in the Province of Quebec, and other places which I might name, where the foundation areas, not being proportioned to the weight to be supported, portions of the structure have settled down unequally, tearing themselves away from others in a disgraceful manner, or to the disgrace of all concerned. I noticed this at J——— some three or four years ago, where the whole front of the church had parted from the side or wing wall, and the salient tower from the remainder of the front, due to its still greater weight, it having sunk eleven inches below datum level, and entailed an expense of some $7,000 or more in reconstruction. Other churches, I am told, as at the St. C. and St. B., have had to be, due to distortion by unequal settlement, taken down and rebuilt in toto.

Now the question arises as to at whose door the fault of such failures is to be laid. I must unhesitatingly say that, generally speaking, the architect is or should be considered the responsible party, and I cannot in saying this be open to any suspicion of partiality towards contractors, being one once myself, having practised as such for over twenty years before entering on civic service, and am still doing so. The architect should in every case plan and specify his foundations in a way that, if so executed, they may be thoroughly reliable, and then in case of the parish, through assumed poverty or otherwise, refusing to put in such foundations, the architect should execute the work under protest, so as to clear himself thereafter and saddle the blame where it belongs. The contractor should act in a similar manner, refusing to build a building under protest both to the architect and to the proprietors or wardens, in case of an improperly and inadequately designed substructure.

If the contractor carry out a plan as specified, he cannot be blamed for any failure due to settlement, as he is not supposed to form the necessary technical knowledge to allow him to judge of insufficiency and the ability of the soil to do what is expected of it in the way of supporting the structure. But the architect is supposed to possess this knowledge, and if he does not he should acquire it, or he is no architect at all worthy of the name. It is deplorable now-a-days that the engineer has to be called in to help the architect through with his foundations, for of the two the architect is the one supposed to have the more difficult problems to deal with sometimes, as in providing against the strains and thrusts to which sidewalks, piers and pillars are subjected by arched roofs or ceilings and domes of masonry, while with the engineer all these strains are conjured into submissiveness by the homogeneity of a pinned together or riveted structure, every part of which is thus tied and bound in a way not to give. What would architects of old have done had they not known how to proportion their resistance to their thrusts? There were no engineers in those days as we have them now. To what engineer did Michael Angelo apply to tell him how stout to build his piers to stand the pressure of St. Peter's dome, to load the supporting soil with weights proportional to their breadth of base? To whom did Christopher Wren address himself to study out the stresses of St. Paul's?—to whom the respective architects of the Pantheon, the Pantheon of Paris? They would have been ashamed, humiliated, to have had to rely in such matters on anyone else's knowledge than their own. It must not be argued that it is not less infra. dig. for the engineer to call in the architect to ornament his structure, make it artistic and acceptable to the age, than for the architect to call in the engineer. No, the cases are entirely different. Art and ornamentation are a branch of architecture, the other two of the three components being constructive and distributive. Then, since the architect must know construction, he should possess all the technical elements thereof, and be able to prepare his own strain sheets, precisely as the engineer does at the present time, the architectural features in the engineer's case being a mere adjunct, while in the architect's case they are an essential.

The written protests I refer to are, of course (and may be more or less disagreeable) unpalatable to some or all of the parties concerned. The architect and contractor both fear that they may thus estrange or rile the proprietors into calling some other architect or builder pliant enough to do the needful and run all risks, "ruat coelum," but the absolute necessity of such action on the part of both architect and contractor in case of foundations of doubtful efficiency, has been so often and disastrously illustrated by the many failures alluded to, and the cost of repairing and rebuilding, that it is to be hoped that proprietors themselves, parish or other authorities, will see the necessity and philosophy of such action on the part of the architects and builders, and it certainly is not fair to saddle the contractor with the cost of underpinning or rebuilding, when they, (the authorities) have from motives of economy decided on a cheap "platform" or "grillage" foundation, where a piled or down to rack structure should have been decided on from the beginning. And in buildings in general, too much reliance is placed on the supporting powers of the outer walls. It is too easily forgotten, and more frequently ignored, that while each of the outer walls bears only one-quarter of the weight, the central wall will have double duty to perform, and hence the fact that so many structures sag at the centre. Another thing of vital importance in the rigidity of a building, and the supporting power of its floor, is that as far as possible every joint should have three points of support, or that they be made to extend from end to end of the building, while supported at the centre, or where there are two intermediate walls, that each alternate joint be made to reach and to bear upon the wall or the opposite sides of the corridors. Where this is not done the floors sag disgracefully towards the centre, and the mere walking across them causes everything in the room to shake and tremble most disagreeably, as with a certain building erected in Quebec, where not from negligence or any consideration of economy, but from sheer ignorance on the part of the architect of the difference between the strength of a beam when secured at the ends and extending to other points of support, as compared with one bearing loosely at its extremities on the supporting beams. Look at the late London, Ont., disaster. Had the joint in this case been of a single stretch from wall to wall, their combined strength, even without the beam which broke, would have gone far towards supporting the weight of the crowd in the room where the collapse occurred, and at any rate their resisting powers added to those of the incriminated beam would have prevented the accident; but on the contrary, every one of the joints were in two length width, their ends meeting on the centre beam, hence the failure.

For The Canadian Engineer.

ROAD MATERIALS AND CONSTRUCTION.

BY W. M. WATSON.

When making roads we have the privilege of copying the system of construction used by the makers of the old Roman roads, which are yet sound and firm, and the later methods used by Metcalf, Tilford and Macadam, who revived the Roman and Swedish process of road-making in a lighter and less expensive form. This country is rich with first-class materials, which only require to be intelligently put together to make good roads. Each old road-making sample shows us that every road and street must have its roadbed well drained. When making a new road the sod and small under brushwood should remain, if convenient, intact, because the rootlets make a tough foundation to build the stone bed on. In places where artificial banks have to be made to raise the level of the road, or when crossing bogs, marshes and soft places, a good thickness of pea straw or brushwood, etc., should be laid across on the soft material before commencing to build the stone foundation.

When the Romans set out a new road, they cut a trench along each side line at least one foot deeper than the bottom of the intended roadbed. These were filled with large boulders, or a rough drain was made, with outlets at short distances into some natural water course, which efficiently drew off all the water from the under side of the foundations. Macadam rounded his roads a little on the surface, the crown being at the centre, giving them a gentle fall to each side. He constructed his roads by laying down three, four, or more layers of stone about six inches thick, rolling each layer down even on the surface to the same shape and grade that the road would finish. He suited his material used to the nature of the ground and the traffic that would afterwards use the road, always placing the largest lumps at the bottom, and rubble varying from one inch down to one-quarter inch for the top course, having the whole rolled hard and tight together, but using no sand or soft material except water. Hard frost cannot hurt a road that has a dry foundation.

Short residential streets might be made to fall a little to a central channel only about one inch deeper than the road surface, placed vertically over the main street sewer, having iron storm water grids that would serve both the purpose of ventilating the sewer and drawing the water from the street. This methed does away with the nuisance of having costly trapped gullies, with large pockets filled with decayed matter, throwing off disagreeable odors, close to the sidewalks and the houses. It saves digging across the street to the gullies, besides the value of the branch lines of pipes from the centre sewer to the gullies. It allows the wagons to get close to the sidewalks, and gives a width of dry road during a rain storm and frosts near to the houses where it is most needed. It also prevents the traffic from passing over the main drain where the road is weakest. Then the roadbed and foundation falling to the centre can be easily made to drain itself into the main pipe sewer, and last, but not least, the side of the streets will not be so slippery as under the present system in frosty weather. This method of grading streets is by far the cheapest, and the pavement is more durable and healthier for our climate.

We now come to roads suitable for traffic in populous cities, requiring smooth surfaces, and we revive again the customs and road materials used by the old Babylonians, and of Egyptians. There are numerous kinds of materials manufactured for roads and sidewalks that will stand any kind of weather, and that may be got at a reasonable cost, wearing from 20 to 50 years, and always be neat in appearance and comfortable to the wearer during the whole of the material's lifetime.

For instance, where high temperature destructors are used to destroy the garbage, the residuum is a very hard burnt clinker and fine ash. C. & A. Musks, of Bootle, Eng., have invented a press and other machinery to manufacture the clinkers into concrete flags equal to stone, and less liable to retain moisture, and I here give a report published of the manufactory at Liverpool, of slabs made from one-third cement and two-thirds clinker, and ash taken from the garbage destroyer.

COST OF MANUFACTURE OF ONE YARD OF CLINKER CONCRETE FLAGGING, 2½ INCHES THICK.

Materials.	Cost.	Remarks.
65 lbs. of Portland cement	10¾d.	Varies with cost of cement.
152 " of clinker................	nil.	Really a saving of 1¾d.
Water	¼d.	This item could be dispensed with where pressure is obtained by using steam power of destructor.
Labor	5½d.	
Plant contingencies and supervision	3¼d.	
Total cost per yard	1s. 7¾d.	

The total cost of manufacture is thus about 1s. 7¾d per square yard, without reckoning the saving in using the clinkers. The sizes of the slabs that are made are 2 feet by 2 feet, 2½ feet by 2 feet, and 3 feet by 2 feet, each being 2½ inches in thickness.

Some of these slabs have been laid twelve months and show no sign of wear. From the experience already gained, engineers believe that this class of flag will have a life as long, if not longer than stone, and owing to the porous material with which they are made, the clinker paving slabs have a foothold much better than the natural stone.

TESTS MADE AT LIVERPOOL OF MACHINE-MADE CLINKER CONCRETE FLAGS 2½ INCHES IN THICKNESS.

Age of flag.	Breaking load applied at centre of flag.	Age of flag.	Breaking load applied at centre of flag.
4 months	........1,804 lbs.	6 months	........2,061 lbs.
4 "	........1,474 "	6 "	........1,966 "
4 "	........1,742 "	4 "	........1,859 "
4 "	........1,917 "	4 "	........1,659 "
4 "	........1,608 "	4 "	........1,589 "
4 "	........1,752 "		

Concrete sidewalks made from granite chips and cement are pleasant and safe to walk on for about eight months in the year, the balance they are very slippery and dangerous. Wood sidewalks are slippery in wet weather, unsanitary, and at all times unsuitable. So that something in the shape of slabs that can be taken up and again replaced, and that are not slippery, also having a smooth surface, seems to be in demand. In places where they use a suitable wood set on a well drained thick concrete foundation, for street pavements, its wearing power is almost equal to good stone, having the advantage of being noiseless and easy for horses' feet. The wood most in favor at the present time in Europe is Australian hard wood, the best being called karri and jarrah. See table of strength, etc., below, prepared by James P. Norrington, C.E., London, England:—

	Local Name.	Weight per cubic foot in lb.	Breaking stress in lb. per square inch.	Elasticity in lb. per square yard.
West Australia.	Karri	65·00	215·00	7,070·000
	Jarrah	56·00	171·00	2,940 000
New South Wales.	Ironbark	73·85	25·08	5,526 400
	Blackbutt	63·69	21·70	3,105·979
	Mahogany	75·06	19·75	3,741 376
	Tallow wood	72·06	16·16	2,274 790

Colonel Bell, United States Consul, at Sydney, strongly recommends his own countrymen to use the Australian hardwood for paving in place of their own lumber. A test made of wood pavements at Euston Road, London, Eng., by James P. Norrington, C.E., proved that at the end of three years, the wear of jarrah and karri was only ¼-inch, and with yellow deal, it was worn down 1⅜-inches. I suppose our Canadian light cedar blocks would have gone out of sight altogether. The same engineer gives the cost of pavement complete with one foot thick concrete foundation to be $3 per square yard.

For sidewalks, cement and brick are good wearing when properly made, having a dry foundation of broken clinkers or coarse gravel. Tar pavements are smooth, durable and noiseless when made with well-seasoned material. The tar should be stored in a cistern for over six months before using, so that the volatile oils and moisture come to the top, and are removed, then mix the tar with clean, small broken stone, say from one to three eighths in size, heated to a high temperature, so that the stone will absorb the tar without ignition. The longer the material is mixed before being used, the better road it will make, say within two years. This kind of road can be freshened and repaired with boiling tar and sharp sand when defects occur.

The best and most durable roads are made of pure genuine asphalt scientifically mixed with suitable materials; but, unfortunately, this is seldom except on sample patches, and the adulterated article cracks, gives out, and rots away under vibrating traffic. Asphalt is found in several countries, the best quality and largest supply is at present at Trinidad.

Asphalt is black and brittle at an ordinary temperature; when broken, the fracture takes the shape of a shell; when two pieces are rubbed together, an agreeable odor is emitted, having no resemblance whatever to coal tar. Crude asphalt weighs 65 lbs. per cubic foot, and refuses to attract moisture. It becomes partially soluble in turpentine, ether, petroleum or naphtha. Almost from the creation of man, what is now called asphalt seems to have been known and used. Its use and value is now being increased. Asphalt pavement is a composition with pure refined asphalt as the basis, mixed with 68 parts of sharp sand, 15 of powdered limestone, and 17 of asphalt, all the portions heated to a high temperature, and mixed by machinery while hot, and afterwards stored in a dry place or carted in a covered wagon to the place needed, and laid down warm. When laid on a firm and strong concrete foundation, the road will wear well, and stand heavy traffic.

For THE CANADIAN ENGINEER.

FRICTION.

BY WILLIAM PERRY.

Friction is greatly influenced by the hardness or softness, smoothness or roughness of the surfaces rubbing against each other. It is in proportion to the pressure or load, that is, a double pressure will produce a double amount of friction, and so of any other proportionate increase of the load. The friction does not depend upon the extent of surface, the weight of the body remaining the same. The friction is greater after the bodies have been allowed to remain at rest for some time in contact with each other, than when they are first so placed; as, for example, a wheel turning upon gudgeons will require a greater weight to start it after remaining some hours at rest than it would at first. The cause of this appears to be that the minute asperities, which exist even upon the smoothest bodies, gradually sink into the opposite spaces, and thus hold upon each other; it is for the same reason that a greater force is required to set a body in motion than to keep it in motion. If about one-third the amount of a weight be required to move that weight along in the first instance, one fourth will suffice to keep it in motion. The friction of axles does not at all depend upon their velocity; thus, a railroad car traveling at the rate of 20 miles an hour, will not have been retarded by friction more than another which travels only 10 miles in that time; it appears, therefore, that the amount of friction is as the pressure directly without regard to surface, time or velocity. Friction is greatly diminished by unguent, and this diminution is as the nature of the unguents, without reference to the substance moving over them. The kind of unguent which ought to be employed, depends principally upon the load; it ought to suffice, just to prevent the bodies from coming into contact with each other. The lighter the weight, therefore, the finer and more fluid the unguent should be.

As regards friction in water pipe, it does not matter whether the water is flowing down or up hill, or whether the pressure is light or heavy, or in long conical and smooth pipes, or whether it is flowing to or from the small end. The total friction will be the same in one or both directions in the first case, and the same in both directions in the last case. In the conical pipe, however, the friction per unit of length or per lineal foot will be less than the average at the large end of the cone, and more than the average at the small end. The total frictional head will be the same as though the whole pipe had a uniform diameter, just equal to the diameter in the conical pipe at the point where the friction is equal to the average for the whole length. I wish it to be understood that when I speak of friction in water pipe, I mean literally what I say —resistance encountered within the pipe by the water, friction in water pipe, not of water pipe. The velocity and resistance vary in different size pipe. If in a section of water pipe we take two points 100 feet apart, and find that with a given number of gallons flowing per minute, the actual pressure in the first instance is 100 pounds, and in the latter 99, we figure that the sum of the resistance in that length of pipe is one pound, or the loss by friction is one pound. If we go another 100 feet we get but 98 pounds, or the friction loss will be two pounds, and the ratio of loss will extend for miles in length. If the number of gallons flowing in the pipe is doubled, still keeping the pressure at 100 pounds at the first point, we shall get about 96 pounds at the second and about 92 at the third point, and we find by doubling the velocity of the flow, we increased the friction loss four times. It is surprising to note the great increase of loss from friction in small over large pipe, discharging equal quantities of water.

Discharging Pipe.	Gallons per minute.	Velocity in feet per second.	Friction in pounds
2½ inches	300	19.6	23.06
3 "	300	13.6	11.2
4 "	300	7.66	2.66
6 "	300	3.40	0.37
6 "	1,000	11.3	3 88
8 "	1,000	6.38	0.94
12 "	2,250	6.38	0.63

In the face of all such facts, towns and villages will use small pipe. I could mention quite a number of towns to-day with a water supply only fit for household service, and crippled in case of fire.

The internal surface of fire hose in a number of cases adds to the loss of pressure by friction to a much greater degree than is generally supposed. The writer's interest in this matter has grown from a desire to obtain better and more reliable information on these very important points. Installing quite a number of fire protection plants in the Dominion has enabled me to go very fully into the matter of friction in hose and pipe; in canvas hose there is a loss of from 25 to 50 per cent., rubber hose from 10 to 30 per cent. Yet from time to time you will see some newfangled coupling introduced. I came across one some time ago arranged as a cone; the idea of the inventor was no doubt to prevent blowing out from the hose. It was $2\frac{1}{8}$ x $2\frac{3}{8}$ in. inside, and intended for fire department $2\frac{1}{2}$ hose. With a test on ordinary rubber hose there was a friction loss of 38 pounds, and with the ordinary $2\frac{1}{2}$ coupling under the same pressure 18 pounds on the same hose. Quite a number of such are on the market. All contractions in couplings, projecting washers, automatic cut-off valves, are very detrimental to the efficiency of flow of water, and are first-class friction producers.

CANADIAN NICKEL.

There is nickel ore in Ontario and New Caledonia, a French possession in the Southern Pacific, which can be profitably placed on the market. The market is world wide, for nickel has been decreed by the leading metallurgists to be necessary to the naval construction of the future, and the demand for warships is limited only by the credit of the nations or the endurance of their taxpayers. The copper bearing Ontario nickel ore is the more profitable, and its competition, although the development has been slight as yet, is said to have almost ruined the French company. Would not these facts lead us to expect to find a great industry in Ontario mining, smelting and refining nickel? Instead of that we have the Canadian Copper Co., whose mines, its manager, R. M. Thompson, stated before a committee of the United States Congress, "are owned entirely by Americans, and in treating whose ores they use American coke." He also stated that the $28,000 per month which the company was obliged to spend in Canada is made up for by the expenditure of $100,000 per month in the United States.* "The Canadian Copper Company is a United States corporation chartered by the Ohio Legislature, in which is only one little stockholder in Canada, holding perhaps one hundred or two hundred shares of the company," stated the president, Stevenson Burke, before the same Congressional Committee. The question now before the Dominion Parliament is whether Canada should not in her own interests place an export duty upon the ore and also upon the nickel matte, which is the product of the smelting process, heavy enough to render it necessary for the company to erect refineries in Canada and give Canadian labor the benefit of the working of Canadian ore. The boards of trade in various leading cities and towns have endorsed this proposal. The sentiment of the public generally seems to be that Canada should have reasonable use and profit of her resources, and that export duties seem the most feasible way of securing it.

It was rather a curious circumstance that at the meeting of the Federated Canadian Mining Institute held in Montreal some little time ago, so determined an effort was made by some of the members to secure an expression of opinion which might be used in the service of this alien corporation. It is certain surely that no stockholder of the company was present because it was a meeting of Canadians, and we have the president's statement that the members of the Canadian Copper Co. are all citizens of the United States, with one exception, and it is hardly likely that out of Canada's millions of people, that one man was present. We are credibly informed that the Canadian Copper Co. paid a ten per cent. dividend last year and carried a comfortable sum to the rest account. We hope the Canadian nickel company may soon do the same.

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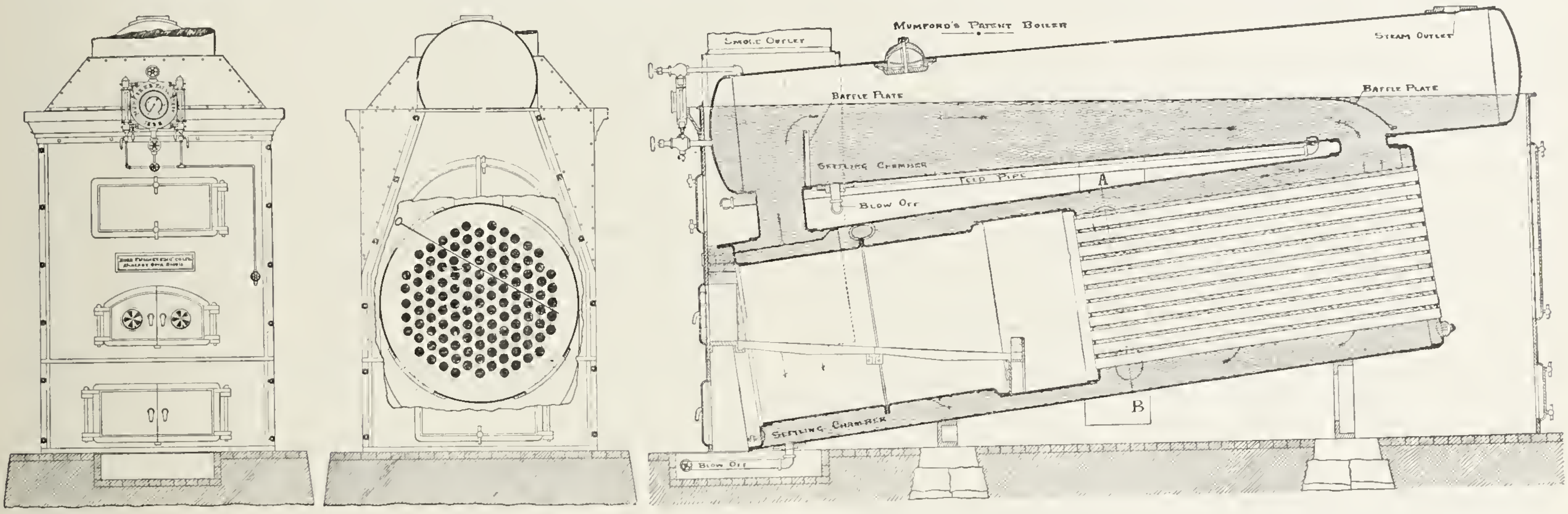
*See Sixth Report Ontario Bureau of Mines.

MUMFORD'S IMPROVED BOILER.

On this page we illustrate a new boiler intended to meet the demand for greater economy and efficiency than are obtained from the ordinary brickset boiler. The water circulation is similar to that of a water tube boiler, and for very high pressure it is built with a corrugated furnace. It was designed by J. A. Mumford, and is manufactured in Canada by the Robb Engineering Co., of Amherst, N.S., and in the United States by a large concern in Erie, Pa. The furnace has ample room for mixing the gases, and is surrounded by water so that the direct and radiant heat of the fire is readily absorbed. The heated gases pass directly through well-proportioned tubes, and return around the shell of the boiler and underneath the drum; thus, it is claimed, making every square foot of the boiler effective as heating surface, and enter the smoke stack with sufficient temperature remaining to produce good natural draft. By covering the case and drum with a non-conducting material the loss of heat is reduced to a minimum. The water circulates continuously from the front to the back of the boiler, up the back connection to the drum, where the steam freely separates from the water, and down the front connection to a point below the fire. This positive circulation admits of using forced draught, increasing the horse-power of the boiler without foaming or priming, the increased temperature increasing the speed of the water circulation, the makers claim, without any evil effects.



Special arrangements are made to avoid trouble with bad water. The feed pipe enters the drum near the back end, and part of the sediment is deposited in a settling chamber at the front end of drum and may be blown out. Additional impurities that are carried down the front connection are deposited in another settling chamber below the furnace. This leaves very little, if any, impurity to form scale on the furnace and tubes, and it may be removed by a scraper inserted through hand holes in the shell, the tubes being spaced so that all can be cleaned. Doors are placed in the casing opposite these hand holes which also give facilities for cleaning the outside of the shell. The Robb Engineering Co. inform us that they have already installed two of these boilers in Montreal, and others in Lethbridge, N.W.T., Fort William, Ont. and Parrsboro, N.S., while a number more are ordered.

THE NAVIGATION OF THE AIR.

Editor CANADIAN ENGINEER:

In your issue for November I notice an article on "The Navigation of the Air," by C. Baillairge, C.E., and thinking some of your less scientific readers might be left in the dark through the nature of his article, I am led to make a few remarks, in the hope that they may somewhat clear the obsurity as to the principle, method and nature of the most successful attempt at aerial navigation in the last few years.

In the article Mr. Baillairge says, "that there never has been an attempt (at imitation), as with flying machines, to imitate in the balloon the shape of a bird on the wing;" and then again he says, "there must be (imitation), to be successful in directing them" (balloons). Now here we have a man trying to advocate an old and exploded theory, that of navigating the air with a machine that is itself many times lighter than the element in which it floats. Not on, remember, as in the case of the ship, which case he tries to parallel with that of the balloon, and says, "as man has become (successful) in propelling vessels through the water, by building them in imitation of the fish." Here we see what similarity exists between a fish and a modern steamship, such as the "Lucania," as ships, I believe, move partly through and partly over the water, whereas the fish moves entirely beneath and through that element. Now as to the propelling power, with reference to that of the fish, again we fail to see the similarity between the two. The fish propels itself by its tail, using its fins as auxiliary motors; but in the steamship, where is the mechanism representing the tail or the fins of the fish? It is true you will find the respective motors in the same relative position, but the resemblance between them I think is very slight. One being an oscillating movement of a fan-shaped appendix, the other a rotary motion of a blade screw. So that we see that the supposed likeness, referred to by Mr. Baillairge, does not really exist.

Then he continues: "Nor will flying-machines ever prove a success until some closer imitation has been arrived at, than heretofore, of the winged denizens of the air." Now, to take some other problems that have been solved by our inventors and mechanical engineers, not in the way suggested, by adhering strictly to Nature's models, but by radical departure in some instances. Firstly, had we imitated the ox or the horse and made the machine which draws our trains to-day, walk on legs, instead of roll on wheels, we undoubtedly would not have had trains whisking us through space at 60 and 112½ miles per hour. Secondly, had our marine architects imitated the fish and his oscillating tail we would not have had a "Campania" or "Lucania" crossing the Atlantic in less than six days, or a torpedo boat rushing through the water at 37¾ miles an hour.

Then is not a flying machine proper, the "aerodrome," a nearer imitation to nature's model than the "soaring machine," advocated by Mr. Baillairge, which is merely what is known as a "steerable balloon," slightly modified? I think so, inasmuch as it is vastly heavier than the air, which fact is true of nature's various models. Then again, he continues, with reference to the relative buoyancy of the balloon against that of the air-ship, "thus, as it is, the balloon is buoyant, but without the proper shape to render it possible to direct its motion, while the 'sky-flyer'—this we interpret to mean air ship, though we never have heard the term used before—is deficient in the opposite sense of having the power of direction without the buoyancy." We doubt if the latter part of the above statement will stand investigation, for surely had the author made the slightest pretence at ærodynamics or æronautics he would have known that the flat or concave surface of any considerable extent (not being prohibitively heavy) when held rigidly at an angle of from 3° to 8°, and moved rapidly forward in a horizontal line, does not need any buoyance outside of itself to retain it in space, its own onward movement being sufficient. That this is the true principle of air navigation has been proved by Langly, Maxim and others. And we may say here without going further, that our inability to steer balloons is not on account of their shape but on account of their weight, or more correctly speaking, the absence of the above property. Had a balloon got the weight, still retaining its floating qualities, there would be little difficulty found in directing its motion.

A little further on Mr. B. tells us to "try to conciliate or combine the two requirements or desiderata."—that of the balloon and air-ship—the two he says must be blended. Believing him to be an advocate of the rule, that "nature must know best," and that in experiments nature's models should be followed as closely as possible, his argument here seems not a little inconsistent. Here we would ask him, if instituting a compartment filled with gas in his flying machine or bird-like structure is imitating nature's model? and if so, in what part of the bird's anatomy the balloon-like structure is located? Further on continues the author, "there is another cause which helps the bird to soar on air" (the first cause mentioned was the bird spreading its wings and extending its tail so as to underlap them, thus forming a kind of æroplane) "this is the very heat generated by the bird's body." Then he asserts that the heat generated by the bird rarifies the air contained in the cavity between the wings. Now, to the generality of us this statement is rather confusing, for heretofore, we were not aware that any cavity existed between the wings, though there may be something of that nature beneath them, it is generally believed that between the wings is located the birds body. As for the air being rarified by the heat of the bird's body and imparted to the cavity or concaved surface of the underside of the wing, thus having a tendency to lift still further or at least retain in space, we think this factor too insignificant to be reckoned with, as figuring out on a scientific basis will prove. In the next paragraph, the writer asserts that "the soaring of the birds of prey is due to their flesh-eating propensities, which creates in the blood a vast amount of carbon, and when brought in contact with the oxygen of the air, in rapid respiration, sets fire to the interior. Now here we have the bird of prey making a veritable furnace out of its stomach by its own action, and the heat generated thereby being used balloon-like, to help maintain its position in space. Then he says with reference to the soaring faculty of the bird, no other explanation can be offered save the one he adduces. Surely this is a sweeping assertion. He then makes reference further on to the "ball-cock" or nozzle mystery, of which he says he gave the first explanation; here again we think he is not quite correct, but he does not give data to his explanation. He states that "increased buoyancy might be obtained under a flying-machine or parachute." Here in particular, as all through his article, he seems to be mixing matters by using such terms as "balloon," "flying-machine," "air-ship," "sky-flyer," "ærostat," "imitative bird," "æroplane," and parachute," some we think peculiar to himself, but most of them universal terms used to designate a particular style of machine for navigating the air, but in this article they all seem to relate to his peculiar machine, whatever he intends to name it, and to the mind of the average reader renders his article rather obscure. Surely it must be a singular looking object that could be called literally a flying-machine or parachute. Then going further with the matter of buoyancy it is asserted that by causing a jet of steam, or a jet of gas or atmospheric air to issue from ball-nozzles or concentric cones, so as to come in contact with the concaved roof of the flyer, and by the mere effect of the friction, suck the air from the funnel-like space enclosed by the jet, thereby forming a vacuum within, and in this way producing buoyancy sufficient to float the flyer, the overplus power of the buoying contrivance to be applied in propelling the "bird-like structure" through the air. Here I would ask the author if he has ever got down to facts and calculated the power and weight of engines or motors of other kinds necessary to compress air or produce steam sufficient to supply ball-nozzle or concentric cone of the number necessary to lift a given weight say of 500 lbs., less the weight of engines (which is not a prohibitive weight, I think, for a practical "sky-flyer") or the area of ceiling or roof for the cones or nozzles to play upon. We think not, or he would have seen that the idea was too absurd to even dwell upon for a moment. But as the writer penned the foregoing statements he seems to have been reflecting, for in the next paragraph he says: "But better still, let the buoyancy be provided for in advance of starting by making the structure a balloon or space-enclosing one." Then he proposes to steer his balloon or soaring machine—for such it really is—by making the propeller shafts capable of separate action, and alternately increasing or decreasing one or the other's speed, in order to keep the balloon on her true horizontal course. How he is going to alter his balloon's vertical course or altitude he does not state, but we presume that this must be brought about by the escape of gas or ballast. With the method of steering suggested above it strikes us that quite a complement of engineers would be required, some one of them at all times would have to be perpetually working throttle, reversing lever, governors or electric switchboard, etc., etc. Here again the writer seems to have reflected on his preconceived method of steering, for in the next sentence he says, "and if the aerostat were provided with a rudder." Again as in other places throughout the article his second thought is infinitely better than the first. At the next bound the reader and his thought of air-ships is landed head over ears among astronomy and astromers, which having nothing in common with æronautics we will pass over without further comment.

And now to conclude with the suggestion to the writer, that if he has such implicit faith and confidence, and believes the principle of his machine to be the only and ideal air-ship of the future, the best method of proving whether his ideas are correct or not would be to have one built on a practical scale and make or attempt to make a flight with it. The danger of such a course is made all too apparent by the history of Dr. Woelfert and his balloon, "Duetschland," which caused the death of the doctor and his assistant, Herr Knobe, on the 12th of May last, at Berlin. This balloon embodied many of the features of the "sky-flyer." For practical matters on æronautic and ærodynamics, I would refer Mr. Baillairge to articles by H. S Maxim, S. P. Langely, Lilienthal and M. Tatin, also Æronautical Annual, 1896-7.

GORDON M. LOCKHART, M.E.

Winnipeg, Man.

The Waterloo and Hespeler Electric Railway wants $40,000 from Berlin and Waterloo, Ont., to extend their line to these towns.

For THE CANADIAN ENGINEER.

THE SWEDISH IRON AND STEEL INDUSTRY AS SHOWN AT THE STOCKHOLM EXPOSITION.*

BY ERNST A. SJOSTEDT, M.E., MONTREAL

Sweden has for centuries been so well-known as a mining and iron producing country that it was expected to have something very interesting in this line to show the world at the Stockholm Exhibition last summer. But even to the most expectant and partial a genuine treat was here in store. For in a most picturesque neighborhood of the beautiful Swedish capital we found the varied products of the country brought together—not in a more or less haphazard manner, but of the choicest only, and this most tastefully and systematically arranged and displayed. The iron industry especially showed a remarkable life and activity; and the more we studied the different exhibits the more we must marvel at the truly wonderful material shown, the like of which has not been produced elsewhere in the world. In fact, such toughness and strength combined with such remarkable softness and pliability as the best grades of the Swedish iron possesses cannot even be approached by other nations, and its tool steel armor plates and projectiles stand highest in the world's market. Compared with any of the great iron-producing countries, Sweden occupies but an insignificant place, for while Great Britain and United States each produced about 8,600,000 tons of pig iron in 1896, and Germany 6,400,000 tons, Sweden can boast of only 545,000 net tons. But what here lacks in quantity is amply made up for in quality, as we soon will see.

In what a healthy condition the Swedish iron mines are, and of what superior purity the ores used at the Swedish furnaces, can be gathered from the following data:—The total number of (net) tons of iron ore raised in 1896 was 2,245,980, as compared with 1,088,120 tons in 1891. The principal producing districts and representative mines are:

		Net tons.
(1) Grangesberg (Dalarne), with an output of		704,000
(2) Gellivara, Luossavaara and Kurunavaara		660,000
(3) Norberg (Westmanland), about		171,000
(4) Dannemora (Upland)	"	60,000
(5) Striberg (Nerke)	"	44,000
(6) Persberg (Vermland)	"	30,000

Of these, the Grangesberg and Gellivara ores are rich in iron (57 to 68 and 60 to 68 per cent. respectively), but high in phosphorus (.05 to 1.25 and .08 to .84 per cent.), and for this reason cannot be used in the Swedish blast furnaces where quality is aimed at, but are exported, the former principally to Germany and Austria where they are used in the basic (Thomas and Gilchrist) processes, and the latter to England, Germany, Belgium and France. All the other representative ores are exceptionally low in phosphorus—from .001 to .03 per cent.—and also in sulphur—from .01 to .05 per cent.—except the Dannemora "pyrite ores" with about 1.25 per cent. sulphur; which, however, are so thoroughly roasted that they do not contain more than .02 to .05 per cent. sulphur when being ready to use in the blast furnace. Upon these two points, the very possibility of the present active condition of the Swedish iron trade rests. And the practice of the great corporations holding the purest ore mines never to sell or export any of their ores, but keeping them for consumption at such works only in which they are interested, gives them practically a monopoly of the best pig iron and steel billet trade, and enables them to obtain a price for their product, in and out of Sweden that would make an American ironmaster feel quite envious, although he may not be disposed to take all the numerous small precautions used here, which, however, are indispensable for obtaining such results.

As most of the iron ores are magnetites (in 1896 87.4 per cent. of the whole production was magnetites, and 12.6 per cent. red hematites), and as the red ores often are so mixed with the magnetic ores that they also are attracted by the magnets, the simple miner's compass has of old been quite an important factor in the discovery and tracing of the Swedish iron ores. During the last 20 to 25 years, however, the more complicated, but also much more accurate and scientific instruments designed by Prof. Thalen† and Mr. Tiberg‡ have come in quite common use. Together with the mining maps, models of the mines are generally made of a series of horizontal and parallel glass plates, on which the sections are drawn in clearly defined colors, representing the different minerals and rocks encountered. These models are without doubt both neat and instructive, and the idea well worth imitating at every mine, as it shows at a glance all the shafts, levels and work-

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*Abstract from a series of articles written for *The Iron Age* while at the Exposition.

† Thalen's Magnetometer, described by the writer in the Journal of the U.S. Association of Charcoal Workers, Vol. VIII., p. 262.

‡ Tiberg's Magnetic Inclination Balance, described by the writer in the Trans. of the Mining Association of Nova Scotia, Vol. II., p. 117.

ings, and thus gives a much surer and clearer idea of its condition than any number of sectional maps possibly can do.

The blast furnaces of Sweden—as well as in the Lancashire process of making wrought iron—are all using charcoal as fuel, and in most of the other metallurgical operations, such as the roasting of the ores, in the heating and open hearth furnaces, etc., the generator gases from wood, forest and mill refuse are used to a great extent. The coal mines of Sweden, namely, which occur only in the extreme south part, in Skane, and from which in 1896 nearly 250,000 net tons of coal were raised, are not of sufficient purity for the iron industry, but are mostly used in the manufacture of firebricks, as good fire clay is associated with the coal beds. Hence it is that sawdust and slabs from the mills, branches and stumps from the forest—in fact anything of a combustible nature—is carefully saved and used in the gas producer, where it is made into pure gaseous fuel, free from sulphur, and thus most admirably suited for the iron and steel processes. Besides the abundance of waterfalls furnishes power for this as well as most other industries, thus leaving for the smelting processes, the lumber and pulp industries, almost the exclusive use of the raw materials of the forest. And as of old the Swedish ironmasters also have been large forest owners, the interests of both these industries have been identical, and the future and continuous prosperity of both have been looked forward to by planting, as well as cutting, and by a systematic working of and most scrupulous saving of the forest products.

Of all the iron and steel exhibits at the Stockholm Exposition it can be said that this excelled in exceptionally good products, and showed an unusual taste and system in arrangement. Conspicuous was also the diversity of products from the same works, showing how few of them really confine themselves strictly to any one particular branch, and how many convert their own raw material—pig iron billets or ingots—either into a half-finished product or into even the smallest articles of trade, many also going into the manufacture of lumber, pulp and paper, etc. The reason of this is evidently to avoid being dependent on the price fluctuation of the raw material, and to enable them to throw the bulk of their working force on that branch, among the different ones pursued, which at the time promises the largest profit.

Owing to the great demand for Swedish bicycle tubes during the last few years quite a new important industry has of late sprung up—namely, the manufacture of tubes of all dimensions. Another healthy branch of the iron industry is evidently the open hearth—especially the basic—process, which is growing in great favor, and from which large castings, as well as small samples were shown at most of the exhibits that testify to the great excellence of the material.

In 1896 there were 140 blast furnaces in operation, producing 544,858 net tons of pig iron, as compared with 502,625 tons in 1890—thus showing but a slight increase, which again is principally due to the limitation of the blast furnace fuel (the charcoal). The average output per furnace and working day was 14.3 net tons in 1896, and 13.3 in 1890, and the largest furnaces (at Domnarfuet) having produced an average of 28.9 net tons, while, of course, some of the smaller furnaces make considerably below the average. The tendency of the Swedish iron industry is indicated from the following table, which gives the proportions of the different kinds of pig irons manufactured in 1892 and 1895:

	1892. Per cent.	1895. Per cent.
For Lancashire and puddling	62.12	52.70
" Bessemer and open hearth	30.53	43.46
" laundry purposes	2.05	1.69
" malleable castings	1.10	1.86
Sprigel	0.19	0.29
	100.00	100.00

For the further manufacture of the pig iron into wrought iron and steel there were, in 1895, 137 different works, and the number of furnaces and the quantity of each class of iron produced were as follows:—

	Net tons.	
306 Lancashire forges, producing	190,517	
35 Franch-Comte forges, producing 33 Walloon forges, producing 16 scrap forges, producing	15,484	
Puddling furnaces at only 4 works, produciug	1,975	
		207,976
30 Bessemer converters, producing (Of which 19,672 tons are basic steel.)	107,247	
33 open hearth furnaces, producing (Of which 22,060 tons are basic steel.)	109,383	
5 crucible steel furnaces, producing	659	
		217,289
6 blister steel furnaces, prcducing		720
Total net tons		425,985

In order to give an idea of the different kinds of manufacture, and the growth during the last few years the following table is of interest

1 metric ton 1,102 net ton. =0 984 gross ton.	1894. Total metric tons.	1894. Per cent. Lancashire puddling.	1894. Per cent. Bessemer and Martin.	1895 Total metric tons.	1895 Per cent. Lancashire puddling.	1895 Per cent. Bessemer and Martin.
Blooms, billets, etc., for export	8,083	0.1	99.9	9,488	0.14	99.86
Iron and steel bars	146,786	67.8	32.2	168,270	61.32	38.68
Other shaped iron and steel not hereafter specified	8,324	8.0	92.0	12,171	1.29	98.71
Hoop iron, horse nails	78,092	59.3	40.7	78,168	55.63	44.37
Wire, in coils	25,764	40.4	59.6	26,038	32.38	67.62
Heavy plates	10,850	0.7	99.3	12,028	0.51	99.49
Rails	3,644	..	100.0	2,884	..	100.00
Fish plates and rail plates	384	45.3	54.7	387	40.31	59.69
Wheel tires	1,391	..	100.0	900	..	100.00
Axles	1,975	34.9	65.1	1,897	17.34	82.66
Anchors and other heavy forgings	1,009	59.2	40.8	695	28.63	71.37
	286,302	55.3	44.7	312,926	49.86	50.14

From this we see that the percentage of Bessemer and Siemens-Martin metal in the manufacture of domestic material was below that of Lancashire and puddled iron until a couple of years ago, when it exceeded it; and the increase in this direction is steadily growing. Another table, showing the relation between hammered and rolled billets and bars and the increasing preference for the rolled product, may also be of interest:

Year.	Hammered. Tons.	Hammered. Per cent.	Rolled. Tons.	Rolled. Per cent.
1892	46,693	34.1	90,306	65.9
1893	43,072	31.8	92,479	68.2
1894	39,738	29.5	94,896	70.5
1895	37,381	24.2	117,229	75.8

Among the several iron exhibits, those of the Sandviken, Domnarfuet, Bofors and Tinspong were the most conspicuous; and the mentioning of a few of their articles will only go to demonstrate the opinion already advanced in regard to the excellent qualities of the Swedish iron and steel, as well as the superior skill displayed in the manipulation.

As samples of special skill in cold rolling long iron bands, the Sandviken Steel Company exhibited an iron band eight inches wide and 2,293 feet long, weighing 1,155 pounds, which decorated the walls and the ceiling of their pavilion, and as a contrast to this "heavy weight" we noticed a "light weight" champion of 4,205 feet in length, and 2⅜ inches in width, but only 43 pounds in weight. The thickness of this cannot be measured in the ordinary manner, as it is only about 0.0012 inch; but a still thinner one, measuring 0.0008 inch was also among these unique exhibits. Another "record breaker" was a band saw 12 inches wide and 214 feet long, handsomely polished and hardened, and "ready for work;" so was also a hot rolled band 290 feet long, 8 inches wide and 5 32 inch thick, weighing 1,241 pounds and made in one heat. This is believed to be at the same time, the heaviest and longest band ever produced in a similar manner in any part of the world. Below this coil was placed a billet of the size from which this band was formed, measuring 11 feet by 7¾ by 4⅜ inches, which object lesson makes one realize with what skill and dexterity this great change of dimensions must have been accomplished—as the result of only one heat.

Domnarfuet Iron Works—the largest iron and steel works in Sweden, and the largest in the world based on charcoal as fuel—displayed some heavy chilled castings, *e.g.*, two 26-inch rolls, about 11 feet in length, and weighing 16,975 pounds each; also open hearth castings, among which two 31-inch rolls of 17,195 pounds weight, and a piston of over six feet in diameter and 3,858 pounds in weight; so also a multitude of samples which had been subjected to the most trying mechanical tests, under heavy drop hammer or by strong torsion and bending, to prove the excellent quality of the material, as none showed any sign of a break or flaw. The superiority of the Domnarfuet tool steel was proved by showing the work done by some of them (duly attested): One of the turning tools had cut and turned off 2,336 pounds of open hearth steel shavings, 566 pounds of cast-iron turnings and 50 pounds of shavings from a chilled cast-iron roll; while a 2-inch spiral drill had bored holes of together about 14 feet depth, making 130 pounds of chips. Among car wheels exhibited by the Sandviken Iron Co., one pair had served during 21 years, and traveled 458,296 miles, and a pair of locomotive tires which had been running 236,817 miles in ten years; also a car axle that, after having run 444,845 miles, was tested and had to be bent 39½ times at an angle of about 10 inches from the neutral axis before it broke.

At Bofors and Tinspong guns, armor plates and projectiles are made, of which the latter especially are renowned at home and abroad, and their power of endurance was shown at a trial practice at Creusot, when the three Tinspong 5.9 inch composition projectiles passed unharmed through the 9.8 inch armor plates made by the French works for the Swedish Government.

The good welding quality of the Swedish steel, as well as the skill of the blacksmith, was demonstrated in a most interesting manner by a piece of steel in the shape of a cube, the end sections of which showed nine small steel squares of different hardness. This effect had been obtained by a perfect welding together of nine square steel bars, with carbon ranging from 0.2 to 1.0 per cent., after which this composite bar had been cut in pieces and polished.

In order to show to what great expense the Swedish ironmaster is prepared to go in order to gain even the slightest advantage in quality of product, it is interesting to note that at some of the works using the purest ores obtainable, they are actually killing out the birch wood, and in its stead planting pine, solely on account of that shade of a difference in amount of phosphorus present in the hard wood, over and above that in the soft wood. But as the trade gives preferences to him who can show the absolute lowest percentage of phosphorus in the steel—if even a difference of .001 per cent.—the wis ironmaster will go even to such a sacrifice—cost what it may, as long as the importer is willing to pay for it—and this England, at least, is always prepared to do for *the very best* material.

Peculiar to the Swedish iron works are their large number of dwelling-houses owned by the companies; but, generally, furnished rent free to the workmen. Although both expensive to build and to maintain, at most of the works this rather patriarchal system is adhered to, instead of allowing the men to buy their own plot and house. Generally, these are neatly built cottages of brick or logs, and pleasantly situated in some park or the woods surrounding the works, and give the impression of prosperity and comfort.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during March and the three months ending March, 1897, 1898:—

	Month of March.		Three months ending March.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£4.955	£2,113	£12,018	£5,418
Pig iron	20	639	455	2.541
Bar, etc.	830	78	3,031	2,285
Railroad	3,295	....	3,847	6.922
Hoops, sheets, etc.	2,700	869	6.311	3,653
Galvanized sheets	2 615	1,916	5,841	4,549
Tin plates	23,141	7 034	61,542	25,549
Cast, wrought, etc., iron	2,252	2,162	7,004	6,133
Old (for re-manufacture)	96	323	572	403
Steel	5,302	5,295	10,235	15,935
Lead	791	1,121	2,070	2,703
Tin, unwrought	947	2,087	5,444	3 476
Alkali	2,606	2,617	4,522	5,516
Cement	750	81	1,843	1,988

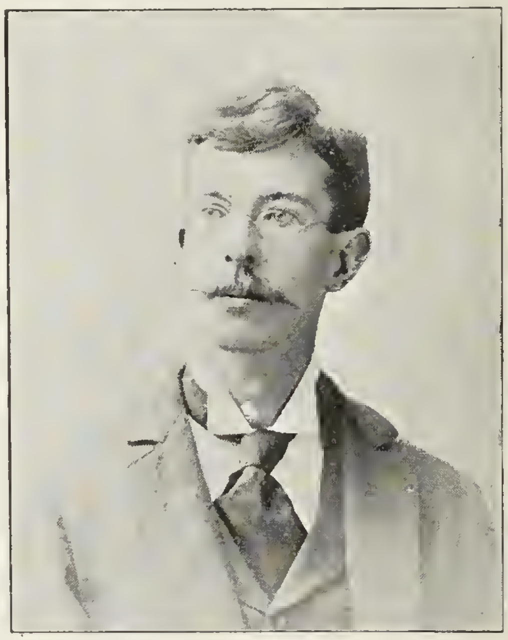
MONTREAL ISLAND BELT LINE RAILWAY.

We described at some length in our last issue the Montreal Island Belt Line Railway. The following additional details of the equipment have kindly been supplied us by C. H. Wright, electrician, and R. Welsford, engineer of the company: The generator is the well-known Canadian General M.P. 200 belted dynamo, and runs at a nominal pressure of 550 volts. The switchboard is the standard marble generator panel, made by the same company, and furnished with its circuit breaker, switches, etc., while the indicating instruments are of the Weston switchboard pattern. The four closed cars are mounted on Taylor double trucks, and equipped with G E. 1,000 motors. The two 45-feet cars are mounted on Taylor double trucks, with G.E. 1,200 motors. The five 30-feet cars are mounted on Brill single trucks, with G.E. 800 motors. The cars are made by the General Electric Company and the Ottawa Car Company. They are lighted with about 225 candle power of incandescent lamps. The line is 00 trolley, with a parallel feeder of 0000 bare wire from the power house, and tapped every 1,000 feet to the end of the line. Bracket construction is used, and the trolley wire is 22 feet from the ground; soldered ears and Crayhead brackets make the overhead work very durable. The bonding is 0000 solid wire, with malleable iron thimbles sweated on. Rails were drilled in the pile with upright hand drills. The cars are controlled by a non-inductive telephone system from the superintendent's office at the power house. The car sheds are located at the power house, so that all the operations of the line are controlled from this central point. The line is completely fenced with Page steel wire fence. The River Side power house of the Montreal Belt Line Railway is situated on the banks of the St. Lawrence, and in the middle of its line. The power house is built of pressed brick of the Ormstown manufacture. The size of the building is 44 feet by 84 feet. The engines and boilers are made by Goldie & McCulloch, Galt, Ont., and consist of one double tandem compound Automatic Cut-off engine, size 13 x 24 x 36 inches. The wheel, 16 feet 6 inches, is belted directly to generator. The boilers are made from the best homogeneous steel, and are double riveted with 84 tubes in each, and tested to 180 lbs. pressure. The condenser pumps and boiler feed pump are made by Northey of Toronto, whose wares are well known to manufacturers. Size of condensers are 6 x 12 inches, and 9 x 12 inches. Size of boiler duplex feed pump 6 inches, 4 inches x 7 niches. The horse power of the engines is 300.

JAMES KINOCH, CHIEF ENGINEER CANADIAN GENERAL ELECTRIC COMPANY.

Jas. Kinoch was born at Blair Gowrie, Perthshire, Scotland, in 1866. The greater part of the years spent in securing his education were passed in London, where he attended the City of London Middle Class School. His technical education was completed at the City and Guilds of London Institute, under the tuition of such able instructors as Profs. J. Perry and W. E. Ayton, and Sylvanus P. Thompson. He graduated from the Institute with great credit to himself.

After completing his technical studies Mr. Kinoch entered the employ of the Globe Electric Engineering Co., where he remained for three or four years. He then became secretary of the Orient Electric Light Co., which position he retained for nearly two years



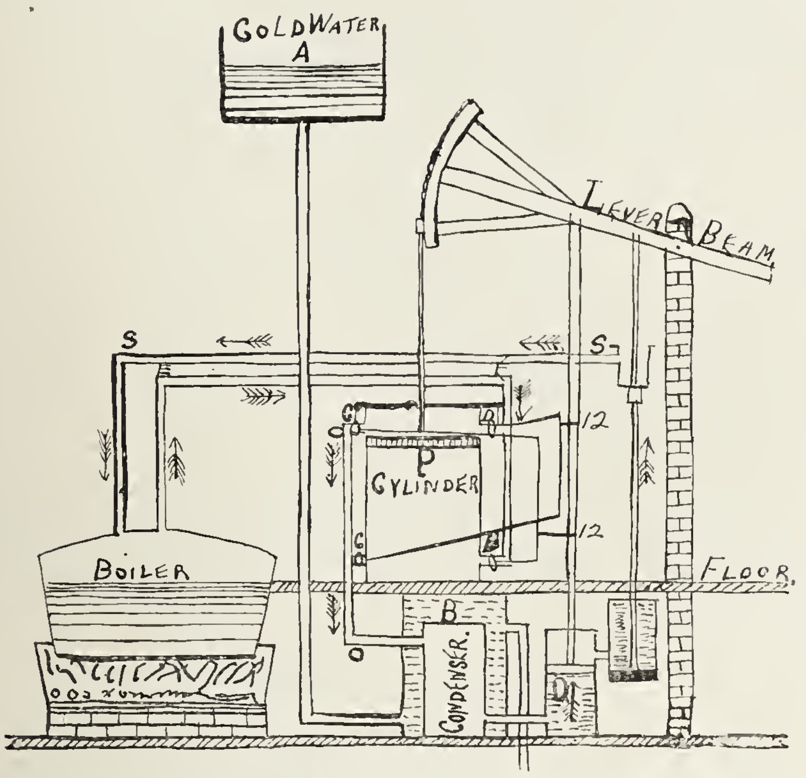
JAMES KINOCH.

After two years' experience as chief assistant to Killingworth Hedges, Mr. Kinoch came to Canada in October, 1891, and entered the service of the Edison General Electric Co. in Toronto. When this company combined with the Thompson-Houston Electric Co., and the Canadian General Electric Co. was formed to carry on its business in the Dominion, Mr. Kinoch was employed as estimating clerk. He filled this position, except for a short time spent with the construction staff on the road, till he was appointed assistant to the chief engineer, and last month received the appointment of chief engineer to the Canadian General Electric Co.

THE STEAM ENGINE.

Editor The Canadian Engineer.

Sir,—In a former paper to your readers I drew their attention to the horse-power or duty, and to Newcomen's atmospheric and steam engine which Watt repaired for the University of Glasgow. His attention was directed to improvements which he saw could be made, and he and Dr. Roebuck went to work to make a new one of a useful size for the Doctor's mine; in his house and in his Carron iron works he fitted rooms for the purpose; there we left him, getting his patterns and casting ready. They had undertaken a big job, as all their tools had to be planned and made. We will now follow him into his room, where he had his steam engine working. Herewith I present a sketch of the engine that was in his mind some time before. The condenser is below the steam cylinder, in a tank of cold water to help the spray or jet of water inside; also he had two pumps connected to the main beam to draw the water out of the tank, and also to fill the boiler feed tank. Here, you may observe, his engine worked with steam both sides of the piston. It was made to work any machinery, as well as pumps in a mine. This condenser formed a better vacuum than could be formed before, and his engine made about fifteen to twenty strokes per minute and ran much higher pressure steam, and by making the vacuum in the condenser as good as possible, so that he might gain 12 or 14 lbs. on the square inch; or, in other words, his pressure of steam on the piston may be that amount less in the boiler; his valve levers are connected to the main beam. The next gain he wanted to make was to keep the cylinder warm, it being exposed to the cold air, as well as the pipes to it from the boiler. He conceived the plan of having another cylinder fitted around it and cased with wood, and let in a little steam at the top, and the condensed water ran out at the bottom, which answered well. This engine he called a condensing engine, and so it is to-day. The piston rod was put through the cover with a gland and stuffing box, as we have to-day, but his workmanship was not so good as ours is: for want of suitable tools, he had quite a difficult piece of work to plan and make the parallel motion. The former engines had a chain over a circular piece at the end of the main beam, the piston rod being a square bar, and a little motion of the piston in the cylinder did all that was required. His piston he made of iron, with a cover or follower, with a space left to pack or caulk in plaited hemp and tallow; when the follower was screwed down it squeezed it against the sides of the cylinder and made it steam-tight. This make of piston I have packed. and it worked well in a slow-motion mine engine with low pressure. Mr. Watt had many other difficulties to be overcome; he yet had taps for admitting and letting out the steam, which were opened and shut by the motion of the main beam, not by hand, as in Newcomen's. But a better sort of arrangement had to be planned out and made; time and money were going away, and none coming in. He lived with the Doctor, and many people were talking about Watt and his new engine.



WATT'S ENGINE.

A, *B*, cold water tanks. *C*, outlet for cold water. *D*, *F*, pumps for drawing off hot water and sending it along *s s* back to the boiler. *P*, tight-fitting piston. *a*, *d*, cocks for letting steam into the cylinder. *b*, *c*, cocks for letting steam out of the cylinder. *e*, *e*, pipe which carries steam from boiler to cylinder. *o*, *o*, pipe which carries steam from cylinder to condenser. *1*, *2*, rods connecting the cocks with the lever-beam.

Watt's mind was fully engaged in planning a valve, in the place of the taps. His leading idea was to have the two valves connected, so that when the top valve opened to let in the steam on top of the piston, the one in the bottom will open to let it out from under the piston at the same time into the condenser. Out of these ideas grew the old Cornish D. and equilibrium valves, also the lever nozzle and foot valves for the condenser. He found his boiler not large or strong enough, because he wanted more steam and higher pressure, and the saving of more steam, also condensing it every half stroke must be done in less time. To do this he got a large tank made and put his condenser into it and covered the condenser all over the top and sides with cold water, the pipes through which the steam passed into the condenser and the condensed water came out to the feed pump, passed through the sides of the tank and the water in it, so that the steam was condensed in much less time. The water in the tank was pumped for use or waste; being warm, cold water was running into the tank to take its place; the two pumps were connected with the main beam. By this plan he had saved a large amount of steam and his engine ran much better and faster, he then put a safety valve on the boiler, and two gauge taps, and caused the fire to burn faster by enlarging and raising the chimney, but he soon found the heat he had in the furnace was 75 per cent. more than was found in the water and steam. In fact, he calculated that only 25 per cent. went into the steam, he also found it took 6 lbs. of water at 32 degrees to condense 1 lb. of steam at 15 lbs. He found that one inch of water at 32 degrees will expand into one cubic foot or 1,728 inches at 15 lbs. There are reasons for believing that these several states of matters are determined by certain conditions affecting the molecular arrangements. We find that one pound of hydrogen, united with eight pounds of oxygen, will produce nine lbs. of water, giving off a considerable quantity of heat. It must be borne in mind that these two elementary substances exist as free gases, so that they can be united or used separately. The word latent means hidden and in this sense we will use it. If we take a glass flask, put it on a stand with a lamp under it, one that will give off a continuous and even heat, put into the flask one pound of water at 32 degrees; watch it taking in the heat, and in one minute, the thermometer will be, say 10 degrees higher. We will now remove the lamp and water, and put into the flask one pound of ice, put back the same lamp and watch the time it requires to melt the ice into water. It takes 14 minutes, but the thermometer marks only 32 degrees the same as the ice did. If the lamp put 10 degrees into the water from 32 degrees to 42 degrees in one minute, then the lamp must have put into the ice 10×14=140 degrees, but the thermometer does not show it, this is what is called latent heat concealed in the ice, which is required to bring back the ice to water. We will now put the lamp on again with the one pound of water which came from the ice at 32 degrees and watch the time it will require to boil up to 212 degrees, the thermometer says steam. It has taken about 18 minutes, or 18m. × 10° = 180° + 32°=212°. Now without disturbing any part of it, watch the time it will require to boil all the water away, and force the steam into another flask through a connecting glass tube, 95 minutes or $5\frac{1}{2}$ times the 18 minutes the time it took to boil from 32 degrees up to 212, and yet the temperature has not risen by the thermometer above 212 degrees, 10 degrees in one minute being raised by the thermometer has become our unit 14m. × 10° = 140°. 18m. × 10° = 180° × $5\frac{1}{2}$=990° + 180° + 140° = 1310° -- 212° = 1098° latent heat in that one pound of ice, up to steam equal to the pressure 15 lb. atmosphere, and if we get steam up to 60 lb., 14 steam atmospheres, we will get into that steam 294 degrees or 82 degrees above 212 degrees; 8 atmospheres will give 342° = to 130° above 212°. Fahrenheit's thermometer. After laying these figures before you, 1098° latent heat and sensible heat 212° + 1098° = 1310° for one atmosphere 15 lb. or 4 atmospheres 60 lb. 1310 + 82° = 1392° or 8 atmospheres, 1392 + 130° = 1522° in steam 120 lb.

About the year 1766 little was known about the air or atmosphere. Watt was very anxious to know something more about it, for he could not burn the fuel without the air, and he wanted to know how to regulate its supply to his furnace in a practical way.

Watt's boiler is what is called the wagon boiler; the bottom sides and ends are curved inward, the top is like the cover of a wagon curved up, made strong with stays to resist the pressure of steam, say 50 lbs. It was built in with bricks, with a chimney behind; when the fuel was put into the furnace, he found it required to be of a light article so as to give a blaze to drive out some of the heavy atmosphere, the chimney and furnace being full with a weight to be overcome by the blaze. The oxygen and hydrogen in the air combined to form drops of water on the cold boiler, and until sufficient heat has been raised to change the water back again into gas, and the atmosphere is driven out of the furnace and chimney, and the bricks have taken in sufficient heat, the fire must burn; and to create a draught in the furnace and chimney the fire must burn, and a large amount of fuel consumed; the heat cannot be brought back or saved for use again, it has done its duty in lifting a weight out of the chimney. Watt complained that not more than 25 per cent. of the heat is caught in the water and steam, while 75 per cent. was gone up the chimney to warm the atmosphere. We will now learn a little from our scientific friends about it; it is a mechanical mixture, not chemically combined, and when in its purest state consists of oxygen, 20.96; nitrogen, .79, and carbonic acid gas, .04, one cubic foot at 32° with a pressure of 14 7 lbs. or 30° mercury weighs 565 1 grains, and one pound is equal to 12.387 cubic feet; it varies one grain for each degree of heat, and is 773 times lighter than water at 32°; the mean weight of a column one foot square, say 45 miles high, weight 2,124.7 lbs. ÷ 144 = 14.7 lbs. per square inch, or ÷ 62.5 will support a column of water 34 feet high, or ÷ 846 lbs. (the weight of a cubic foot of mercury); it will support a column of mercury 30 inches high. If we build a chimney 60 feet high, for a boiler 60 inches diameter by 16 feet long, with tubes sufficient for an engine 24-inch cylinder, and a 36-inch stroke, the inside flue of the chimney should be at least 24 inches square. A round flue is the best; we have at the bottom of the chimney the atmosphere pressing 2124·7 × 4 = 8498·8 lbs. This great weight must be moved before we can reverse the pressure and cause an upward draught, and to do so we must burn some pounds of light fuel, and also to heat the brick in the furnace and chimney; this heat has to be kept up or maintained by the burning of the fuel, beside the heat or energy put into the steam for actual work every minute. I do not wonder at Watt being much surprised to find that his engine did not get more than 25 per cent. of the heat or energy produced from the fuel. The engineers of to-day are complaining of the same thing, and many of them say: "We have brought the engine to a nice appearance for workmanship, economy and usefulness, but the principal part we have so far not handled successfully, viz., how to build in our boilers; are they made of the right stuff and shape, and our chimney," could not some other material be used, mica, or anything that will not give off so much heat? When this 25 per cent. loomed up in Watt's mind, he planned a different shape boiler. In one he put two large tubes in a round shell with a fire in each; but he found, if both the fires were not kept alike, it did not do justice to the boiler, and the water inside he then put in one large tube, and put the fire into it, hoping to get more heat into the steam than when the fire was outside, he found it worked better; this plan is now generally adopted in different shapes, but this plan did not, nor does it now, save the large percentage of heat leaving the boiler and going up the chimney to keep out the pressure of the atmosphere and give an upward draught or upward current not to burn, the air or oxygen, as some say, but to change the hot atmosphere and fuel into gas. A large number of new inventions have been made within the last few years, yet we are not perfect; but there is plenty of room for new plans left."

THE CONSTITUTION OF HYDRAULIC CEMENTS.

A series of experiments to determine the constitution of hydraulic cements has recently been made by S. B. Newberry and W. B. Newberry and described in a paper read before the Society of Chemical Industry. The questions which the authors have attempted to solve are as follows:—

1st. What proportions of lime must be employed for given percentages of silica and alumina in a clay? 2nd. Can a general formula be stated, applicable to all clays, which shall indicate the proportion of lime which will give the best result with each? 3rd. What effect has the presence of oxide of iron in the clay used on the proportion of lime required, and on the quality of the resulting cement? 4th. Is the presence of alkalies in the raw materials necessary to the production of good cement? 5th. Is magnesia capable of replacing lime in cement mixtures, or is it inert, as has often been stated, and how does magnesia affect the quality of the cement obtained?

The plan followed in the efforts to solve these questions was that of synthesis with pure materials, which materials were as follows:—1st. Silica; ground quartz, in impalpable powder, containing 99.19 per cent. silica. 2nd. Alumina; C. P. precipitated, containing 99.50 per cent. alumina, .20 per cent. soda, .05 per cent. iron oxide and .25 per cent. silica. 3rd. Carbonate of lime; precipitated chalk, containing 99.7 per cent. calcium carbonate. 4th. Iron oxide; red, German C. P. 5th. Magnesia; German, C. P., containing only traces of silica, alumina and lime.

All these materials were in the form of a perfectly impalpable powder, and none of them left any residue on a sieve of 180 meshes to the linear inch. Mixtures of these materials, in calculated proportions, were made by rolling backward and forward on a large sheet of paper, then sifting three times through a 60-mesh sieve. The mixtures were then moistened with water, made into a cake, dried and broken into small pieces for burning. The burning was done in a Fletcher gas furnace, using gasoline gas as fuel.

The conclusions to which the writers are led by the above experiments may be briefly stated as follows: 1. The essential constituents of Portland cement are tri-calcium silicate, with varying proportions of di-calcium aluminate. This composition may therefore be expressed by the formula—

$$X\ (3CaO.SiO_2) + Y\ (2CaO.Al_2O_3).$$

From this formula it may be calculated that the correct proportion of lime, by weight, in Portland cement, is 2.8 times the silica plus 1.1 times the alumina. 2. Iron oxide combines with lime at a high heat, and acts like alumina in promoting the combination of silica and lime. For practical purposes, however, the presence of iron oxide in a clay need not be considered in calculating the proportion of lime required. 3. Alkalies so far as indicated by the behavior of soda, are of no value in promoting the combination of lime and silica, and probably play no part in the formation of cement. 4. Magnesia, though possessing marked hydraulic properties when ignited alone, yields no hydraulic products when heated with silica, alumina or clay, and probably plays no part in the formation of cement. It is incapable of replacing lime in cement mixtures, the composition of which should be calculated on the basis of the lime only, without regard to the magnesia present.

—The Government of New Brunswick has placed an order with the Good Roads Machinery Co., of Hamiton, for ten steel Champion road graders. The company is also shipping one of its well known Champion rock crushers, road rollers and engines to the town of Magog, Que.

TO ESTIMATE HORSE POWER.

Editor Canadian Engineer:

(a) In the question below please inform me in The Canadian Engineer why "3" and "2" are used, that is, where they get the "3" and "2" in the text book of which I am studying. The question is: Required the horse power of an engine having one cylinder 30 inches diameter, 36 inches stroke, making 90 revolutions per minute, boiler pressure 75 lbs. per square inch, cutting off at ¼ stroke, vacuum 26 inches, mean effective pressure on piston throughout stroke 50.5 pounds per square inch.

$$\frac{30 \times 30 \times {\cdot}7854 \times 50{\cdot}5 \times 3 \times 90 \times 2}{33000} = 584{\cdot}1234 \text{ H.P.}$$

(b) Does black oil in a boiler destroy the scale, or does it injure it?

Young Engineer.

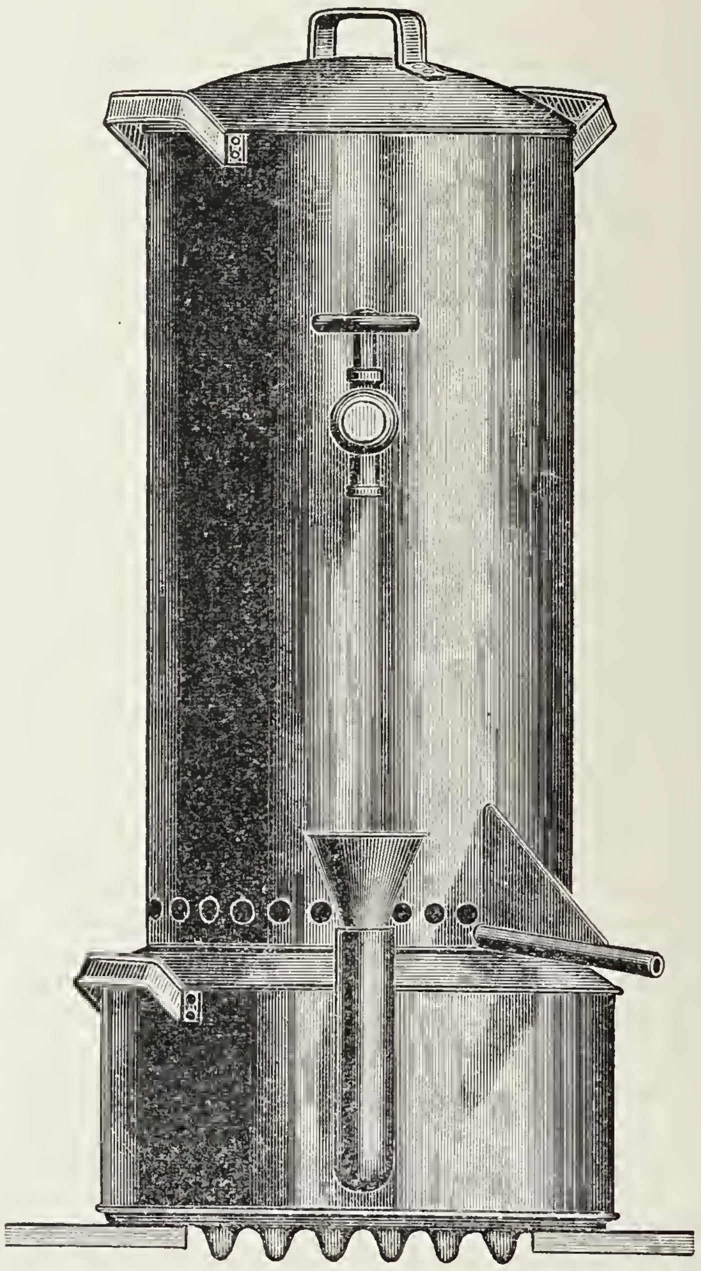
Midland, Ont.

(a) The "3" referred to here by our correspondent is the number of feet in the stroke, and the "2," is the number of revolutions per minute.

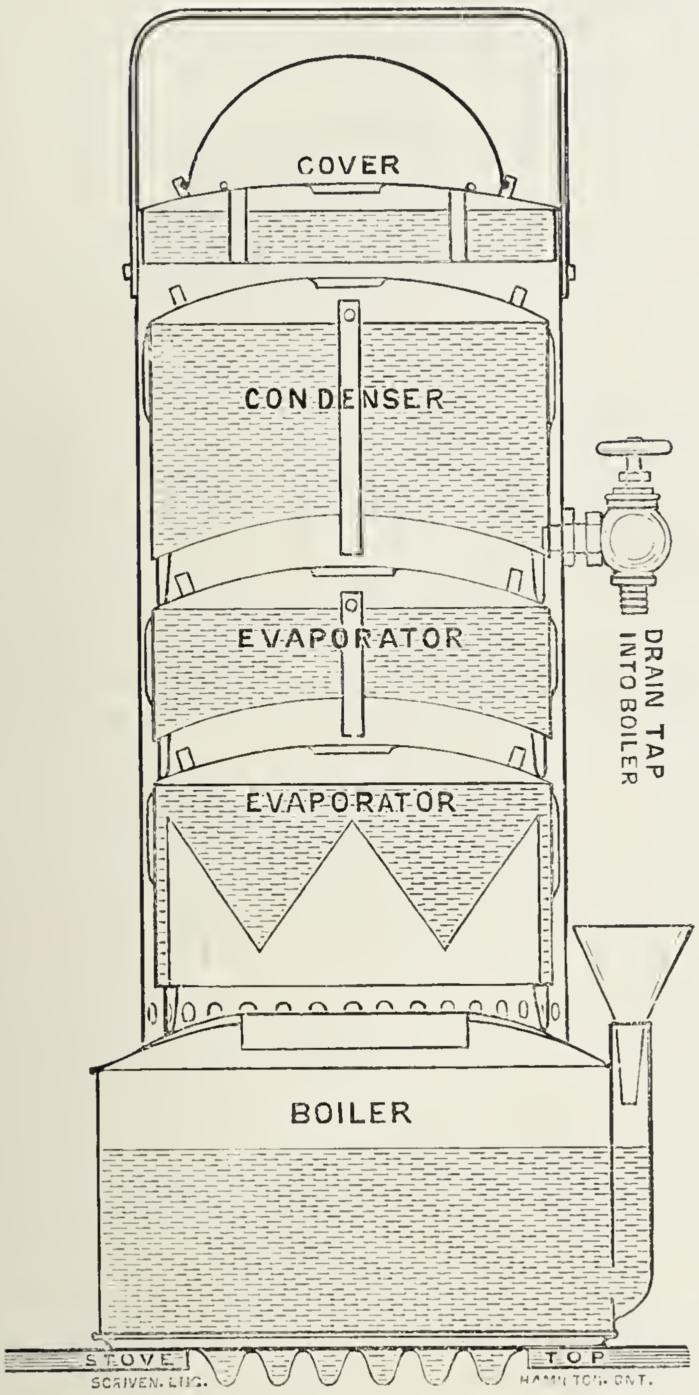
(b) The Boiler Inspection and Insurance Co. does not allow the use of oil as described. We would advise "Young Engineer" to write to some of our advertisers for information on the subject of scale in boilers.

DISTILLED WATER.

The accompanying illustrations show the New-Life Water Still for producing aerated distilled water for drinking, culinary and hygienic purposes. The action of the apparatus is as follows: The water to be operated upon is placed in the lower vessel or boiler, and when boiling is placed on the kettle, and the steam passes into, around and under the evaporators, heating them to nearly boiling point, by which a part of the water they contain is evaporated and is condensed by contact with the upper vessel or condenser; a constant current of air passing through the holes at the bottom of the condenser is carried up and sterilized by coming in contact with the steam, and, the maker claims, combines with the product, which is pure distilled water, freed from all calcareous, organic and deleterious matter. The water is pleasant to the taste, satisfying, will relieve thirst, and can be borne by a weak



stomach when "raw water" is not possible, and being divested of all injurious solids, acts as an absorbent, assisting nature to carry on the natural functions of the system.



The New-Life Water Still is the invention of J. H. Killey, mechanical engineer, Hamilton, and is protected under industrial design No. 1,360, and manufactured by the New-Life Still Co., 37 King William Street, Hamilton, Ont.

ONTARIO LAND SURVEYORS.

The sixth annual meeting of the Association of Ontario Land Surveyors was opened pro forma at the Repository of the Association in the Parliament Buildings, Toronto, on Tuesday, 22nd February, and adjourned to meet at the same place on the 8th March and the two following days. At the adjourned meeting the chair was occupied by T. Harry Jones, of Brantford, president. The attendance was larger than at any of the last three preceding years, and a lively interest in the proceedings was shown throughout.

Meetings of the council of management, board of examiners, and the standing and special committees for the association, year 1897-98, occupied the morning of the first day, the first session of the general meeting being held in the afternoon. The minutes of the previous meeting having been published in the annual report for 1897, the formality of reading them was, on motion, dispensed with. Letters were read from C. E. Gauvin, president of the corporation of Provincial Land Surveyors of Quebec; W. F. King, Dominion Astronomer; Capt. E. Deville, Surveyor General; Herbert Wallis, past president of the Canadian Society of Civil Engineers; Professor McLeod, secretary of the Can. Soc. C.E.; also from Joseph Kirk, of Stratford, an active member of the association, now in his 88th year, and from Sandford Fleming, C.M.G. A communication from the mayor of Hamilton, through E. G. Barrow, city engineer, inviting the association to hold its next annual meeting in that city, was also presented, and M. J. Butler and George Ross were appointed a committee to frame a suitable reply thereto. The president then introduced Wm. Hamilton Merritt, who exhibited a field equipment for prospectors, and explained the method of operating it. Its weight being only 27 lbs., it is easily transported, and would serve a useful purpose. The annual address of the president was next read, and a brief account of the history of the association during his term of office therein presented. V. Sankey, chairman of the council, presented the report of the council, including those of the board of examiners and secretary-treasurer, the financial statement being then handed to the auditors for verification. From these reports it was shown that the association had lost nine members by death during the preceding year, and eleven candidates had been admitted to practise at the two meetings of the board of examiners.

Reports of the committees on Publication, and on Repository and Biography, were read by Captain Gamble and H. L. Esten, the president announcing that a suitable album had been procured, and requesting that members who had not already done so would present their photographs to the last-named committee. In the absence of V. M. Roberts, his paper on "Acetylene Gas and its Uses" was read by H. H. Gibson. This paper set forth the advantages of acetylene gas over other luminants. H. D. Q. Sewell then read a paper on "Progress on the Lake of the Woods," being a supplement to a former article which he had contributed.

D. D. James read a paper by V. M. Roberts on "Water Power from the Niagara River," and discussion of various sources of water power in Ontario and Quebec for conversion into electric energy followed the reading.

After referring to a number of schemes of power development, which were more or less visionary, the writer took up the plans of the Welland Power and Supply Canal Co. to construct a power canal from the Welland River to Lake Ontario. The proposed canal will be fifteen feet deep, one hundred feet wide at the bottom and one hundred and sixty feet wide on the water line, and the slope of its sides and banks two to one, having its intake on the Welland River near the village of Montrose, and will flow through the townships of Stamford, Niagara and Grantham to Lake Ontario, being fed by the Niagara and Welland rivers. The Welland River rises in the county of Wentworth, a few miles south of the city of Hamilton, and flowing through a comparatively level country empties into the Niagara River about two miles above the Falls and is navigable for some thirty miles above its mouth. A canal or cut was made some years ago by the Dominion Government from Chippawa, a small village at the mouth of the Welland River, southerly across the northeast corner of the township of Willoughby into the Niagara River, to allow vessels bound for Welland to enter the river without risk, connecting with the Welland Canal at Port Robinson. The current of the Niagara River forces its waters through this cut, and its influence is felt some twelve miles up the Welland River. Seven miles north of the Welland River the canal reaches what may be termed the Bluff, to distinguish it from the Niagara escarpment, of which it forms a prominent and isolated portion; seven miles north of this point is Lake Ontario. Between the point of intake and Lake Ontario there is a difference in elevation of 316 feet, of which 184 feet is available at the Bluff, 66 feet in the vicinity of the Queenston and Grimsby stone road, 33 feet in the vicinity of the Niagara stone road, and 33 feet at or near the mouth of the Eight Mile Creek, every foot of which can easily and with advantage be utilized for the development of power.

The engineering features in connection with this immense undertaking are, for the most part, of an extremely simple nature; difficulties similar in all respects to those which will have to be surmounted, having already been successfully overcome in the construction and maintenance of the new Welland Canal, which lies about two miles to the west, and is a standing proof of the feasibility of the power canal. In the spring of the year when the disruption of the ice which has formed in the Welland River during the winter months takes place, the extremely swift current of the Niagara River, above the Falls, keeps the mouth of the Welland River open and carries the ice away immediately, preventing ice jams. The intake of the canal will leave the Welland River about three-quarters of a mile above Montrose bridge, at such an angle with the river as will afford protection from ice coming down stream, and crossing a small knoll, enters the bed of a creek flowing into the Welland River about half a mile lower down, and follows its course for about one mile and a quarter, thence almost due north across the height of land to the bluff, crossing under the Allanburg cut-off of the Grand Trunk Railway and the St. Catharines and Niagara Central Railway, and over the Great Western Division of the Grand Trunk Railway, thence following the general course of the Eight Mile Creek to Lake Ontario.

The deep cut on the proposed canal will be about 65 feet, the slope of sides of cut and canal will be two to one in earth, and have a batter of one in twelve in rock. A short distance south of the crossing or aqueduct over the Great Western Division of the Grand Trunk Railway a regulating weir will be constructed of first-class masonry. The aqueduct will be similar in all respects to that on the new Welland Canal where it crosses the same railway about one mile to the west, being composed of a masonry tunnel, covered with puddle clay properly tamped and rammed to form the bed and banks of the canal. A storage basin or reservoir and head race will be constructed at the bluff, which presents about six thousand feet of almost perpendicular sides, in the form of a semicircle, down which the water will be conveyed through steel tubes to the turbines. From the bluff to Lake Ontario the cutting will not be heavy, the canal being formed alternately in cut and fill, masonry dams and sluiceways being built at the point of power development.

At the opening of the evening session the president announced that a committee of the Can. Soc. C.E. desired to confer with the association, represented by a committee, on the subject of the proposed incorporation of civil engineers in Ontario. Messrs. Sankey, Butler, Niven and Gaviller were then appointed to discuss the matter with the representatives of the civil engineers, and report to the association before the close of the annual meeting. An interesting report on "Exploration" was then read by E. Stewart, chairman of that committee, and discussion ensued, after which a paper on "Forestry in its relation to Land Surveying" was read by T. H. Southworth, Provincial Clerk of Forestry, who showed the immense importance of attention to this subject to the future of Canada. His statements were heartily endorsed by several speakers, M. J. Butler adding facts and statistics in support. The Economic Resources of the Hudson Bay District was the subject of a paper by J. W. Tyrrell, whose experience and observation in the far north made him an undoubted authority on many of the particulars as to the wealth of that part of the Dominion, so little known to the great majority of Canadians. Capt. J. D. Williams presented a paper on "Some Causes of Loss in Gold Mining in Ontario."

Wednesday morning session opened with an announcement by the president that the publishers of The Canadian Engineer had kindly presented to the association a number of copies of its issue of February, 1898, containing a biographical sketch of Wm. Ogilvie, the most prominent member of the association. A. W. Campbell, chairman of the committee on engineering, then read a comprehensive report of the works which had come under the notice of that committee during the year.

Capt. W. F. Van Buskirk read a paper on the Sewerage Purification Works of Worcester, Mass., and replied to several questions brought up by members in that connection.

The capacity of the works is now upwards of 15 million gallons per day, providing for the entire dry weather flow of the sewers. The lime used for precipitation is slaked and mixed with water in two tanks, 8 x 6 feet each, the mixture being agitated by compressed air delivered by perforated wrought-iron pipes placed in the bottom of the tanks. The milk of the lime is delivered to the main outfall sewer by an iron pipe entering at a point about 100 feet above the screen chamber. Sulphate of alumina was formerly used with the lime, but was discontinued. The quantity of lime used is about 900 lbs. per million gallons of sewage, or 40 tons per week, at a cost of $6 per ton. This quantity is much less than is generally used, owing to the fact that the sewage of Worcester contains at times large quantities of iron salt from wire works, which is run into separate tanks and used gradually in connection with the lime. After receiving its charge of lime the sewage passes through a screen chamber, where all large substances are removed; thence flows down a mixing channel with rather a rapid fall to the channels between the settling tanks, whence it is directed, along with a small amount of the sewage containing the iron salts, into the various tanks by means of movable flash boards. The sewage passes slowly from one tank to another, the solids in suspension gradually sinking to the bottom, until it reaches the last one in operation, whence it flows out over a weir to a channel which conducts it to the river. The effluent looks bright and transparent, but appears to contain a considerable quantity of lime in solution at times, as the stones with which the outlet channel is paved were coated with lime. From one to three tanks are "cut out" each day, and after being allowed to stand quiet for a short time, the clear liquid is drawn off by means of hinged floating arms from pipes provided with valves passing through the walls of tanks. The sludge deposited in the bottom of tank is then run off to the sludge well through masonry channels located under the sewage channels between the tanks. It is then pumped from the well by a Shone ejector, the air for which is compressed by power from a water wheel driven by the effluent from the tanks of the main outlet. After leaving the well the sludge is deposited on beds, where the water is gradually drained off. The sludge has not been utilized to any great extent, but it is reported to be growing in favor, and presses are being put in which will leave the material in a form that will permit of economical handling or disposal.

Notwithstanding the fact that nearly all of the suspended matter is removed, the town of Millbury entered action a short time ago to compel the city of Worcester to further purify its sewage, and in consequence of such action the city employed Samuel M. Gray and Dr. Drown to make a report on the plant. They have recommended that the effluent from the works be further purified before being discharged into the river, and for this purpose an area of ten acres is being prepared for sand filtration. There is a little doubt, however, whether this will abate the nuisance or not, as the river bed and mill ponds are still covered with the organic matter deposited before the works were put in operation, and during heavy storms since that time when the whole of the sewage was not passed through the tanks. The report above mentioned affords further evidence of the fact that purification by chemicals is an incomplete process and that the lime and organic matter remaining in the effluent may give trouble when discharged into streams and small bodies of water. The experience of Worcester is particularly interesting as being in all respects similar to the experience of England, where it is found that notwithstanding the many improvements in settling tanks and in the methods of applying chemicals, it is not possible to produce effluents of sufficient purity to be discharged into the smaller rivers without causing complaints, and as a consequence the effluents are generally subjected to further treatment by rapid filtration through gravel coke, or some such material. Chemical precipitation, it is true, may in some cases give a degree of purification sufficient for the conditions which obtain, but the writer is of opinion that it will in most cases prove less expensive to treat sewage by rapid filtration through gravel, aided by a current of air and when the conditions demand complete purification, the effluents can be filtered in the ordinary way at a very high rate per acre. It has been shown by experiments conducted by Board of Health of the State of Massachusetts, that rapid filtration through gravel or coke gives an effluent comparable in all respects with that obtained by chemical precipitation under the most favorable circumstances, and has the advantage that the sludge is disposed of, as it is consumed in the pores of the filter. Recent experiments in England confirm the conclusions of the Massachusetts Board of Health, and we may expect in the near future to find many of the chemical plants supplanted by more scientific and less costly methods.

A paper on "Evidence," that mysterious bugbear of candidates for admission to practice as land surveyors, was presented by M. J. Butler, whose training and practical experience in this connection fitted him to the task, and in the subsequent discussion it was suggested that Mr. Butler prepare a text-book on the subject, so far as it related to land surveying.

Sudbury waterworks was the subject of a paper prepared by L. V. Rorke, and, in his absence, read by D. D. James. This paper formed a valuable addition to the collection of articles on waterworks already published in the annual reports. Professor C. H. McLeod, secretary of the Canadian Society of Civil Engineers, having arrived from Montreal as a representative of that body, was welcomed and introduced by the president. The report of the Committee on Polar Research was read by J. W. Tyrrell, chairman.

The first order of business for the afternoon session was a paper by Jas. Hutcheon on "Specifications," containing many valuable hints.

A. P. Walker then read his paper on "The York Street Bridge," extracts from which appeared in the last issue of The Canadian Engineer. "An Illustration of the Necessity for Accurate Descriptions" was the subject of a paper by George Ross, who gave the history of an important question of title to lands at Point Abino, Lake Erie, which had been the cause of much litigation. P. S. Gibson, well known to all surveyors admitted within the last thirty years, next read a paper on "Assessment Plans," describing the requirements of such plans and exhibiting a specimen sheet of a set recently prepared by him for the township of York.

The report of the Committee on Land Surveying, with Question Drawer, was presented by M. Gaviller, chairman, with answers to several knotty points sent in by members who appreciated the advantage of having an advisory board of experienced practitioners, whose duty it is to give the benefit of their opinions to any who seek them. A list of cases compiled by M. C. Schofield, an active member in the 80th year of his age, after 55 years of practice, was referred to the incoming committee for classification, and a question as to the position of shore or bank of a lake or river from which a road allowance is laid off, was also held over. The report of the Standing Committee on Topographical Survey was read by L. B. Stewart in the absence of the chairman, Otto J. Klotz. This committee continues its work, notwithstanding the lack of present results, but its efforts will eventually be crowned with success. M. J. Butler presented a description of sand cement, the product of recent improvements in manufacturing methods. This paper may be more fully discussed in a later issue. The evening was devoted to the annual dinner, that function which has done so much to promote a closer acquaintance among individual members, and which this year eclipsed all previous occasions in point of attendance and enjoyment.

The session of Thursday morning opened with the presentation of the report of auditors, which was read by H. L. Esten. A paper on the Kinburn Swamp Drain, prepared by F. W. Farncomb, was read in his absence by the secretary, and described a case where the judicious investment of a few thousand dollars had resulted in the reclamation of waste lands, the value of which had amounted to several times the amount of the sum expended. H. J. Bowman read a paper entitled Arbitrators and Witnesses, dealing with the respective attitude which should be taken by each. In the absence of W. M. Davis, his paper on "The use of Field Tile for Large Drains," was read by A. S. Code. The writer showed the superiority of tile drains for several reasons. The following table gives approximately the comparative cost of open and tile drains of various depths:—

COST PER ROD.

Depth.	Open Drain.	Field Tile 6 in.	8 in.	10 in.	12 in	14 in.	18 in.
3 feet	$1 08	0 90	1.20				
4 "	1.80	0.96	1 26	1.86	2.19	3 00	
5 "	2.52	1 27	1.60	2.00	2.40	3 60	5.00

It would appear from the above that for depths up to 5 feet, and for sizes of tile up to 12 inches, the tile drain has the advantage, considering only first cost, and taking all things into account field tile of any size capable of carrying off the water, and for any depth, are cheaper than an open drain. In deciding on the size of tile it is not necessary to provide a capacity that would be ample for a culvert, neither is it safe to calculate on a drain having twelve months in which to dispose of the annual rainfall. In this latitude a rainfall exceeding one inch in twenty-four hours is exceptional, so that this quantity may reasonably be taken as a basis for our calculations. Not more than one-half the rainfall can be depended on to reach the trunk drain, a proportion which decreases as the area of the watershed increases. If the water can be removed within forty-eight hours, as a rule, no damage to the crops will result, therefore a trunk drain that will convey about 900 cubic feet of water per acre in twenty-four hours will be ample for ordinary drainage; lateral drains will require a greater capacity depending on the facility with which the rainfall reaches the tile.

Tile over twelve inches in diameter should not be less than two feet in length, as they can be laid more evenly; they should be particularly well burned, and moulded from the toughest clay; many qualities of clay, which make fair tile of small size, are totally unfit for those of large diameter. The thickness should increase from one inch for 12-in. tile to 1¾ inch for 18-in. tile. Two factors of vital importance in drainage are: perfect alignment and grade; the curves should not have a less radius than 60 feet. An accurate grade can best be obtained by means of "boning rods;" that is, by placing two bridges across the trench about 300 feet apart, the tops being adjusted so that a line joining the top of one with the top of the other will be parallel with the grade line. A rod equal in length to the distance of this line from the grade line is then used to obtain the exact elevation of each tile; this method is especially advantageous when working in quicksand. Catch basins or manholes should be placed about 1,000 feet apart to admit of easy inspection of the drain; they should have a pit 18 inches below the grade line for the purpose of intercepting sand; they also provide a convenient means of connecting lateral drains Wherever possible, these catch basins should be placed at crossings of fences.

In accordance with the usual practice, the report of the committee on entertainment was taken as read, and ordered to be printed in the annual report. Professor McLeod addressed the association on the subject of proposed incorporation of civil engineers in Ontario, and explained its objects and its relation to the position occupied by land surveyors. The discussion on the report of council was begun, and lasted the remainder of the session. In the afternoon the discussion on the report of council was continued, and by-laws numbers 45 and 46 were ratified. Under motions, the papers on "Unrecorded Original Field Notes," by J. J. Murphy, and "Lake Erie Survey," by Otto J. Klotz, also the report of the committee on drainage, were taken as read, and ordered to be printed in the report.

Since the date of the meeting the balloting for the election of officers for the ensuing year has resulted as follows:—

President—P. S. Gibson, elected by acclamation.
Vice-President—H. J. Bowman "
Sec.-Treas.—T. G. Van Nostrand "
For Council of Management—F. L. Foster and J. L. Morris.

The report of the committee appointed to confer with representatives of the Can. Soc. C.E., was presented by Major Sankey. A cordial vote of thanks was tendered the retiring president for the manner in which the duties of that office had been fulfilled by him, after which the meeting adjourned.

The Hess Metallic Furniture Company, Niagara Falls, Ont., has begun building and will probably be the first company to use electric power developed on the Canadian side of the river for manufacturing purposes.

MANUFACTURE AND USE OF SAND CEMENT.

The following extract from a paper by C. B. Smith, McGill University, Montreal, was read by the author at the recent meeting of the Canadian Society of Civil Engineers in Montreal:

The use of sand cement has increased in Europe, and particularly in Denmark (where it was invented), during the past five years, and it has been tested by several American engineers, with satisfactory results, and has been used in the proportions (1 to 1) to 3, in the concrete for the foundations of St. John's Cathedral, New York, in which 3,000 yards were used, and in other places.

The advantages claimed for the material are, that where great strength is not required, mortars will be more dense, stronger, and will work more smoothly on the trowel, in which a portion of the sand has been ground together with the cement, before use in the mortar. Another claim is that the cheaper grades will replace lime mortar in plastering, as it will set and dry quicker, and also, again, that in dock walls a very dense concrete can be produced which will prevent the destructive percolation of sea water.

Tests made at St. John's Cathedral foundations gave the following results:—

		Compression.
(1) Sand cement (1 to 1) Concrete.	(1 to 1) 2 sand 3 gravel	1 week—2,144 lbs. per sq. in. 2 weeks—2,312 lbs. per sq. in. 4 weeks—2,588 lbs. per sq. in.
(2) Sand cement Mortar.	(1 to 1) sand cement. 3 sand.	1 week's tension 156 lbs. 2 weeks' tension 188 lbs. 4 weeks' tension 200 lbs.
(3) Portland cement. Mortar, 1,500 bbls.	1 cement. 3 sand.	1 week's tension 137 lbs. 2 weeks' tension 170 lbs. 4 weeks' tension 179 lbs.

The paper concluded with a description of the plant at Glen Falls, N Y., where tube mills and flint pebble balls are used in grinding, and a statement that the American sand-cement output is ground very fine (5 per cent. residue on 180 mesh sieve), the tests will show higher results than those in the table which is added, giving tests made in Europe on sand cement mortars of various proportions.

The usual proportions in America are (1 to 1) and (1 to 6), the former competing with Portland cement and the latter with lime.

(The manufacture of sand cement has been begun in Canada by the Rathbun Co., of Napanee Mills, and the St. Lawrence Cement Co., of Montreal.)

EXTRACT FROM EUROPEAN TESTS IN GERMANY AND DENMARK.

TENSILE (WATER).

Mortar.	1 wk. lbs.	4 wks.	3 mos.	6 mos.	1 year.
(1 to 2) to 2......	142	242	299	384	400
(1 to 3) to 2......	114	185	228	271	326
(1 to 6) to 2......	57	114	156	..	220
(1 to 12) to 2......	43	114	128	157	142
(1 to 24) to 2......	28	57	57	57	57

COMPRESSIVE (WATER).

Mortar.	1 wk. lbs.	4 wks.	3 mos.	6 mos.	1 year.
(1 to 2) to 2......	1,080	1,795	2,148	2,578	3,365
(1 to 3) to 2......	497	1,080	1,637	2,008	2,485
(1 to 6) to 2......	200	384	667	....	1,050
(1 to 12) to 2......	171	384	726	796	866
(1 to 24) to 2.. ...	128	270	370	370	383

TESTS ON SAND CEMENT.

MADE IN M'GILL COLLEGE LABORATORIES.

(*a*) (1) Iron clad brand Orlen Falls (1) Sand:—

	Tension.		Compression.	
Neat.	1 wk.	4 wks.	1 wk.	4 wks.
	475	602	3,380	4,650
(1 to 1) to 3....	73	105 pressed.		
(1 to 1) to 3....	..	185 rammed.	1,060	1,120 rammed.

Blowing test good residue 1.5 % on No. 100 sieve.

(*b*) (1) Aalborg, Denmark. 1 Sand (Cathedral brand).

(1 to 1) to 1	279	398	1375	2012
(1 to 1) to 3	44	66	..	300

This is from a barrel which was supposed to be damaged.
Residue 1.2% on No. 120 sieve. 0.7% on 100 sieve.
" 18 0 % " 180 "

(*c*) (1) Star (Rathbun). 1 Sand (Ensign brand).
4 months, 800 lbs.

Neat.	1 wk.	2 wks.	1 wk.	2 wks.
(1 to 1) to 3..	66	95 pressed.	..	400 pressed.
(1 to 1) to 3..	183	192 rammed..	..	880 rammed.

Residue 0.6% on 100 sieve.
" 1.0% on 120 "

(1) Star (Rathbun). 6 Sand (Jubilee brand).

4 months, 340 lbs.

Neat.	1 wk.	2 wks.	1 wk.	2 wks.
(1 to 6) to 1..	213	230 pressed.	..	1350 pressed.
(1 to 6) to 1..	242	292 rammed.	..	2112 rammed.
(1 to 6) to 2..	184	215 "	1225	.. "

0.3% residue on No. 100 sieve.

1.3% " " 120 "

(1) Star (Rathbun). 1 Sand (Citadel brand).

Tension. Compression.

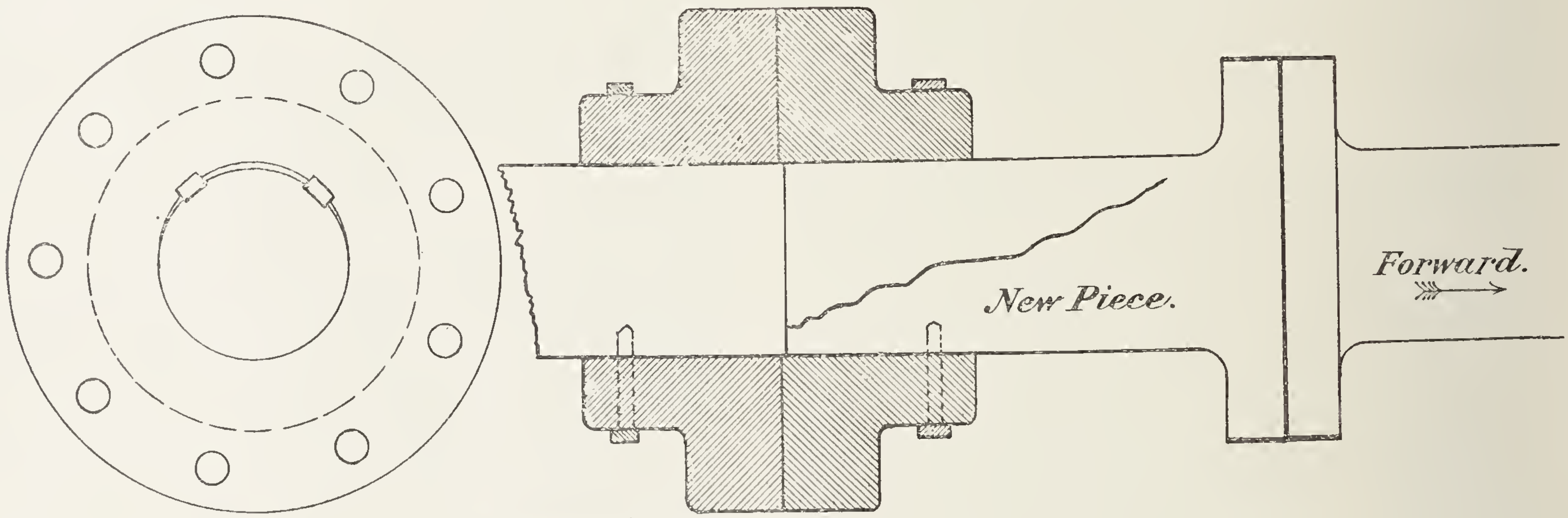
Neat.	1 wk.	4 wks.	1 wk.	4 wks.
(1 to 1)......	332	475	1800 (?)	3837
(1 to 1) to 3..	135	141 rammed.	470	687 rammed.

0.2% residue on 100 sieve.

0.5% " 120 "

REPAIRS TO S. S. MONARCH.

The accompanying sketch illustrates the method devised by Wm. Golding, consulting engineer to Lloyds Surveyors, at the port of New Orleans, L. A., for repairing the fractured shaft of the steamship Monarch, which vessel cleared from that port on the 25th of November last, for Liverpool, carrying one of the largest cargoes ever taken from an American port, consisting of 22,535 bales of cotton; 60,000 bushels of grain; 11,200 sacks of meal; 29,068 staves and 242 head of cattle. Soon after sailing, a fracture developed in one of the 8 sections of the tunnel shaft, necessitating the return of the vessel to New Orleans, where she arrived without assistance on the 30th of November, 1897. To renew and remove the shaft would require several weeks' time, necessitating the removal of a large portion of the large cargo. It was therefore decided in the interest of all concerned, to repair the shaft in place, and make the renewal at port of destination.



Scale 1/16 Full Size.

As shown in the sketch, the shaft was cut off in place, while the vessel lay at anchor in the river; the new piece was forged, turned and fitted; the large coupling cast, bored and turned, and the entire work completed in less than 12 days after the vessel's return; the success of the undertaking is attested by the arrival of the vessel in due time, at port of destination. The value of vessel and cargo was estimated to be $1,250,000.00.

PROSPECTOR'S OUTFIT.

Editor Canadian Engineer:

A frend of mine who intends to go prospecting before long through the Omenica district, asks if it would be advisable to take an inexpensive outfit for testing ores, with a suitable textbook on same.] He knows nothing whatever of analysis or assaying. Will you kindly give me your opinion on the matter, and if you think it would be judicious for him to take an outfit such as mentioned above, what would it need to consist of and what work on the matter would you recommend as the most suitable, that is to say, the simplest and most practical? By giving information asked for you will greatly oblige

Yours truly,
Subscriber.

British Columbia Southern Railway,
Wardnor, B.C., 5th April, 1898.

[Ed.—We would advise your friend to secure a copy of either "Gold and Silver Ores," by W. Hamilton Merritt, or "Pocket Mining Manual," by J. H. Chewett, both of which will be found in the book list on page III. of this paper. The following is a list of articles required for field work, it being taken for granted that the prospector is already in possession of a rough knife for scratching minerals, a pocket compass and a small magnifying glass:—

Sampling—1. "Mixing cloth," or smooth waterproof sheet, 4 feet square. 2. Brush, broad (varnishing brush). Panning—3. Gold-pan, Russia iron (not to be used with quicksilver.) 4. Iron mortar, 5 in. by 6 in., and pestle. 5. Sieve, brass wire, 40 mesh, in tin dish with cover. Pan-Amalgamation.—6. Two gold pans, one ordinary iron, the other graniteware. 7. Nitric acid, strong, in 2 oz. glass-stoppered bottle. 8. Mercury, 1 lb. in bottle. 9. Sodium, 1/8 oz. in bottle, with naphtha. 10. Hand-scale, "Traveler's letter and parcel balance," weighing 1/4 oz. to 12 ozs., for weighing mercury and pulp. 11. Balance, hand scale with sliding weight on beam, very sensitive, from 0.1 to 5 grains, for weighing beads of bullion and weighing out charges for quantitative blow-pipe assay. 12. Mercury retort, small, Russia sheet-iron 1½ x 1¾ inches, or small cast iron retort, with cover and pipe to collect mercury. Also sheet of Russia iron 8 inches square (with hole for supporting the Russia iron retort in the centre) for quartering when sampling. 13. Porcelain dish, and porcelain thimble, small, for parting in. 14. Graniteware cup and saucer, small size. 15. Brass wire sieve, 60 mesh. 16. Wooden pestle. 17. Sheet lead, pure, 2 ozs. 18. Sheet silver, pure, 1/8 oz. 19. Borax glass, ground, 1 oz., in deep round tin box. 20. Soda, 1 oz., in deep round tin box. 21. Litharge, 4 ozs., in deep round tin box. 22. Bone-ash, 2 ozs., in deep round tin box. 23. Paraffine lamp, tin, with 1/8 lb. paraffine. 24. Blow-pipe. 25. Two clay pipes, one mounted for cupelling, the other for heating mercury. 26. Charcoal, 3 pieces, sawn square. 27. Pincers for small buttons. 28. Steel anvil, 1/4 x 1½ x 2 inches. 29. Small piece thin asbestos card. 30. Hammer, small. 31. Magnet. 32. Smooth-headed bolt, for making cupels in clay pipe. This outfit will determine the value of free milling ores as low as of any economic value; it will enable the proportionate yield in concentrates to be qualitatively tested as to their precious metal contents. Quantitative determination of concentrates outfit. 33. Plattner's ivory button scale. 34. Clay crucibles, 1 doz. 35. Clay capsules, 2 doz. 36. Fletcher's blow-pipe furnace with side hole. 37. Camel-hair brush. 38. Flour, 1/4 oz (?) in tin box. 39. Methylated spirits, 1/4 pint. 40. Common salt, fine, 1/2 oz., in tin box. 41. Nitre, 1/2 oz., in tin box. 42. Spirit lamp, tin. With the above mentioned outfit free-milling ores can be tested, and value determined as low as $1.50 per ton for gold ores, and much lower for silver ores, if desired. Also the value of the concentrates, or of melting silver ores, can be approximately estimated. The weight of the outfit is about 20 lbs.]

CO-OPERATIVE SETTLEMENT.

Editor Canadian Engineer:

Sir,—The prospect of early work on the Georgian Bay and Ottawa Ship Canal, together with the agitation for a railway to James' Bay, give point to a suggestion I made regarding a co-operative settlement by men of intelligence and some financial means. I know a point where these enterprises must intersect, if the shortest route, with the best land adjacent, are considered important. The shore of the Georgian Bay is rockbound round the north, and admission must be sought where a bay or navigable river penetrates the coast range of granite or Huronian mountains. Spanish River, Parry Sound, Cutler and Thessalon, are examples of such entrances; while French River, White Fish, Blind and Mississagrea Rivers are barred by falls at their mouths. Now a navigable bay, penetrating to the arable land, and accessible in all weathers, is a very desirable point from which to start a colonization road. If, in addition, unlimited water power, cheaply controlled, be added, with a choice of routes through good country for

50 miles to form a Hinterland, then I hold an ideal location will be selected. The port and settlement would be on Laurentian territory, with iron, mica, granite, galena and gold, as minerals to be expected; its rear would be the contact with Huronian, on the same lines as the Wahnapitae gold formation. The probabilities would amount almost to a certainty, that paying mines would be one of the assets of the colony; that the port would be a distributing point on the James Bay railway; and that a good farming background would give stability and weight to the commercial, manufacturing and mining features of the enterprise.

As suggested before, an electric railway to progress with the onward wave of settlement, should be a prominent feature. Supposing Sudbury to be the first objective point on the James Bay route, our line would run obliquely to N. E. of it, and act as an auxiliary rather than a rival. While the first cut of pine has been taken off the district, the hardwood, pulp timber and bark is yet untouched, and might amount to a valuable consideration. A company with, say, 1,000 shares of $100 each, to be sold at par only, and employing only shareholders (if enough offer) to do the work; with no speculators, and no drones; with a store at which all supplies are furnished at cost; and with all mechanical appliances furnished by the members at special rates; with electric light, power, carriage, and even board, at rates to meet actual outlay, the conditions of settlement would be so much superior to the general conditions of pioneers that colonization would be shorn of its chief discomforts. If you could leave the crowded streets, vile odors, competitive battle, dress parade, and taxes of city life; but carrying school, church, library, literary and musical socials with you, into a healthier climate, with more profitable employment, abundant fuel, fruit and flowers—in short a natural life—who would hesitate to embark in it? You cannot choose your company in city life—you may in the country.

HOMO SENEX.

THE DOMINION ESTIMATES.

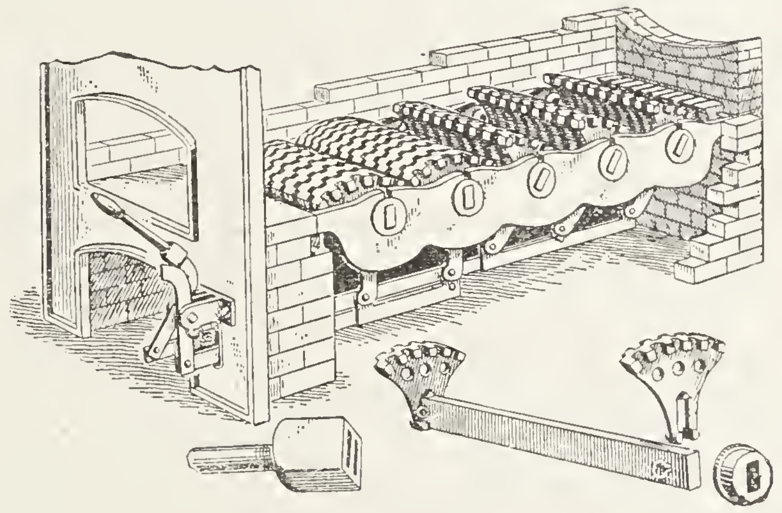
RAILWAYS.		
Intercolonial Railway—		
Sundry improvements	$280,600	
Extension to Montreal, to pay rental to Grand Trunk Railway Company for railway from Chaudiere to Montreal, to be operated as part of the Intercolonial Railway	210,000	
		$490,600
Prince Edward Island Railway—		
Improvements		18,500
CANALS.		
Soulanges Canal—Construction		1,610,000
Cornwall " enlargement		160,000
Farran's Point "		325,000
Rapide Plat "		250,000
North Channel, straightening and deepening		50,000
Galops "		1,275,00
River Reaches		50,000
Lake St. Francis, removal of boulders, etc.		50,000
Trent		603,200
Sault Ste. Marie—Construction		45,000
Lachine		155,000
Lake St. Louis Channel, straightening and deepening		65,000
Grenville—Enlargement		40,000
Williamsburg Canals		9,000
Murrray Canal		1,000
Rideau "		875
HARBORS.		
Nova Scotia—		
Various wharves and breakwaters		38,900
Prince Edward Island—		
Piers, wharves, etc.		40,650
New Brunswick—		
Wharves, dredging, etc.		43 200
Quebec—		
Piers, breakwaters, wharves, dredging, etc.		97,700
Ontario—		
Wharves, dredging and piers		234,200
Manitoba—		
Repairs, improvements, etc.		28,000
North-West Territories—		
River and bridge work		5,000
British Columbia—		
Improvement of channels, etc.		51,500
PUBLIC BUILDINGS.		
Nova Scotia—		
Halifax drill hall		18,000
Kentville public building		5,000
Liverpool "		5,000
Ontario—		
Kingston drill hall		10,000
Sarnia public buildings		5,000
Manitoba—		
Portage La Prairie post-office		8,000
British Columbia—		
Victoria public buildings		16,000

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The eleventh annual dinner of Hamilton No. 2, C.A.S.E., was held in the Commercial Hotel, April 7th. There was the usual large attendance, and the evening passed most pleasantly. The menu was excellent, and was done full justice to before the toast list was presented by the chairman, R. Mackie. During the evening music was interspersed by Messrs. Jardine, the Eleon Club, J. R. Dixon, Stanley, Hastings, A. Child, W. G. Blackgrove, F. Mitchell, and D. Marentell. J. Bain acted as accompanist. The dinner committee was R. Mackie, chairman; Joseph Ironside, secretary; P. Stott, W. R. Cornish, W. Stevens, R. E. Chillman, R. C. Pettigrew. The toast list was as follows: The Queen; Canada our Home, responded to by A. Hartwell; Mayor and Corporation, responded to by Alds. Hernside and Pettigrew; Manufacturers, responded to by J. McGlauchlin, of Toronto; Educational Interests, responded to by J. S. Williams; Executive Head, responded to by E. J. Philip, A. M. Wickens, of Toronto; Sister Associations, responded to by Messrs. Mooring and Dixon, of Toronto; Hamilton No. 2, responded to by R. Mackie; The Ladies, responded to by A. P. St. John; Host and Hostess, responded to by Messrs. Moxey. A pleasant feature of the evening was several selections by the gramaphone, operated by Mr. Morrice.

ROBERTSON'S SHAKING AND DUMPING GRATE BARS

The shaking and dumping grate bars of which the accompanying engraving gives an idea are manufactured by Jas. L. Robertson & Sons, 204 Fulton St., New York, who are successors to the Heine & Robertson Co. The firm is very favorably known to the trade, not only in the United States, but in Canada as well. The makers state that nearly seven years use, under conditions of unusual severity, has demonstrated their efficiency and durability, and the recent changes in design, tending to greater strength, enable them to promise even more satisfaction in the future. The grate is composed of a series of replaceable leaf castings, a best quality wrought iron cross bar, protected from the heat, and durable bearings in which, it is claimed, friction is reduced to a minimum. Frames for seven sections and under are made without truss.



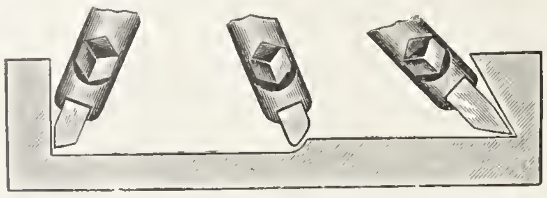
L'ASSOCIATION DE SECOURS MUTUELS DES INGENIEURS MECANICIENS.

This association held its annual meeting on the 25th ult. under the presidency of Ephrem Valiquet. Associated with him were Louis Gayon, Factory Inspector; Alex. Bonin, Prof. at Laval University; J. A. Rodier, and the association's legal adviser. The election of officers resulted as follows: President, Ephrem Valiquet; 1st Vice-pres., Henri Beauchamp; 2nd Vice-pres., Mathis Guimond; Treas., Wm. Gendron; Fin. Sec., Eteinne Leroyer; Corresponding Secretary, Alex. Blair; Asst. Sec., Jos. Guimond; Trustees, Magnus Lessard, Arthur Coulombe, Alphonse Provost; Conductor, Arthur Alix; Doorkeeper, Telesphore Leclaire; Employment Agent, Ephrem Valiquet; Delegates, Gendron, Denis, Coulombe. After the

elections many good speeches were made, tending to emphasize the fact that the objects of the association were mutual benefit and improvement, not what is understood as labor organization in any form.

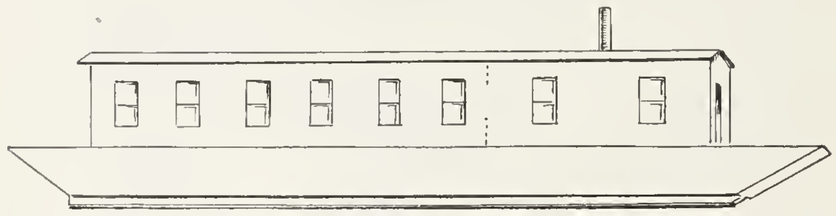
INTERESTING TO LATHE OWNERS.

A practical substitute, of self-hardening steel, for forged tools for general lathe and planer work, especially adapted for economical use, is shown in the accompanying cuts. These tools possess, the makers claim, all the good points of a forged tool, and are made in variety of sizes in straight right and left hand offset, and in the form of a boring bar. The makers claim a saving of 90 per cent. tool steel, that is, one pound of steel used in a holder will do the work of 10 lbs. used in the old way, and also a saving of 70 per cent. in grinding. The Goldie-McCulloch Co., McClary Mfg. Co., Toronto Electric Motor Co., Bertram & Sons, J. J. Stevens, and many other leading Canadian manufacturers, have adopted these tool holders. Further information can be obtained from the Aikenhead Hardware Co., Toronto.



AN OTTAWA RIVER HOUSE BOAT.

Bannerman & Findlater, manufacturers of boilers, etc., Ottawa, who recently moved into their new premises, which were rebuilt on a larger scale after the fire of last year, have recently turned out an interesting job in the shape of four lumbermen's "house boats," for the Upper Ottawa Improvement Co. These are the first iron house boats built in Canada, two of them being for use at Quio (Chats Lake), and two on the Ottawa, at Pembroke. These boats—a diagram of which is given herewith—are scow-shaped, each 51½ feet long over all, with a keel of about 42 feet; 12 feet wide at the top, and 11 feet across the bottom and 3 feet deep. The bow tapers to an extent of about 6 feet, and the stern 4 feet. The keel is formed of a piece of timber 7 inches deep and 6 inches wide, and is protected by an iron shoe. The house stands 6 feet above the top of the hull, making a height of ceiling of about 9 feet. The kitchen and cabin occupies about one-third of the house, the rest being occupied by sleeping berths, of which there are two tiers, a tier on each side of the boat with a gangway through the middle, making accommodation for a crew of twenty-four. The house is clap-boarded with an iron roof.



NEW PLANT FOR THE WAR EAGLE MINES.

The War Eagle Cons. Mining & Dev. Co., of Rossland, B.C., have just closed a contract with the James Cooper Mfg. Co., Limited, Montreal, for a Duplex Ingersoll-Sergeant Air Compressor, and a 300 horse power Electric Hoisting Engine. The compressor is a Duplex machine of the latest type having two 24¼" by 48" air cylinders, and is ample at normal speed to furnish sufficient air for 50 drills. It will be operated by a 500 horse power motor, and in place of belting, 22 cotton ropes will be used to drive the machine. As an evidence of the size of this machine, it may be stated that the fly wheel is 20 feet in diameter and will weigh, when finished, about 25 tons. Mr. Mills, the Consulting Mechanical Engineer for Mr. Gooderham, after an extended tour through the mining districts of Montana, California and British Columbia, and after making exhaustive tests of the efficiency of the various types of compressors, decided to adopt the piston inlet type of machine as being the most economical. The hoisting engine, which is to be operated by electricity, is of 300 horse power, and has double drums arranged for two-compartment shaft, and is capable of hoisting from a depth of 3,000 feet, the normal working load being 8 tons, and the speed 1,000 ft. per minute. The motor for the hoisting engine is of the induction type, and can work up to 600 h.p. It is reversible and can run at any speed up to synchronism. Not only will the compressor be the largest machine ever built in Canada, but both the compressor and hoisting engine will be the largest machines on this continent operated by electricity, and it speaks well for the enterprise of Rossland mines, that they are foremost in the field of up-to-date machinery. The motor for the compressor is a 400 h.p. synchronous machine and will run at 200 revolutions per minute. The electrical equipment is being furnished by the Canadian General Electric Co., of Peterboro, Ont., and the machinery when completed will aggregate about 15 carloads. The plant is to be delivered on cars in ten weeks from receipt of order, and should be on the ground inside of three months. The power will be derived from the works of the West Kootenay Power Co. The War Eagle mine has now been proved to a depth of 625 feet, giving an estimated amount of ore in sight of $3,500-000. In one place the vein is exposed to a width of 50 feet, giving an average assay of $25. The force of miners is to be increased to 50 men.

CANADIAN ELECTRICAL ASSOCIATION.

At the last meeting of the Executive Committee of the Canadian Electrical Association, it was decided to hold the convention on Tuesday, Wednesday and Thursday, the 28th, 29th and 30th of June, in Montreal. The headquarters of the association during the convention will be at the Windsor Hotel, where the business sessions and the annual banquet will be held. The draft programme, recommended by the local committee of arrangements, with some slight amendments, was adopted, and is as follows:

First Day.—Executive meeting 9.30 to 10 a.m.; session, 10 a.m. to 1 p.m.; session 2 to 5 p.m.; 7.30 p.m., trip round Mount Royal by special Park and Island cars, afterwards ascending Incline railway, to lookout on mountain to view the city under illumination.

Second Day.—Session, 9 to 12, noon; cabs and busses from Windsor Hotel at 1 p.m. to visit: (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Co., returning to city at 7.30 p.m.; 9 p.m. annual banquet of Association at Windsor Hotel.

Third Day.—Session, 9 to 12 a.m., election of officers and visit to McGill University; 1.30 p.m., visit to Royal Electric Company's lighting station and factory, then by special G.T. train to visit the works of the Chambly Manufacturing Company at Chambly.

A number of very interesting and instructive papers relating to various phases of electrical work have been promised and are in course of preparation. Negotiations are in progress with the object of securing special transportation rates to enable a large number of the western members to participate in the proceedings of what will undoubtedly be a very pleasurable and instructive occasion.

THE E. & D. WHEEL.

The factory of the Canadian Typograph Co., manufacturers of the celebrated "E. & D." bicycle, is pushed to its full capacity. The Globe, in a recent notice of this wheel, says: "The bearings of this bicycle were invented in Canada in 1895, by Canadians, and the wheel is built only in Canada and exported throughout the world. It is the first and only Canadian bicycle that has successfully entered the United States market, and Canadians have a particular reason for feeling proud when it is known that this wheel commands a higher price than any wheel in the United States, and that it is sold there at an advance of from $15 to $20 above its price in Canada. Perfection of movement has always been the particular theme of this company, and they have every reason to feel proud of the reputation they have gained in so short a time by their wonderful hub. We are informed that they have never yet supplied a cone or ball for this bearing, nor ever been asked to replace one. They defy their competitors or others to show a cone out of their wheel, no matter how long it may have been in use, that shows the slightest indication of wear. They also challenge the public to destroy one of their bearings or to make it bind, no matter how tight it may be screwed up. The wheel is guaranteed to run the year without being oiled or cleaned, no matter how many miles it is ridden, or how much dirt is encountered. The bearings also are guaranteed against wear for three years. They never require to be adjusted or interfered with. The Typograph Company has a special model this year, which includes the Doolittle automatic brake. Simple back pedalling applies the brake, and when once applied, the foot can be removed and the brake remains, while forward pedalling immediately releases the brake, so that the rider has complete control of his wheel, whether his foot is on the pedal or not. This model also includes a new gear case, composed of aluminium and celluloid. It can easily be removed and leaves the chain and sprockets at all times exposed to view. It is also so arranged that the back wheel can be adjusted without in any way disturbing the case.

BOILER EXPLOSION AT ORILLIA.

The boiler at Miller's tannery, Orillia, Ont., exploded on Good Friday evening, wrecking the building and causing damage to the extent of over $5,000. At the close of the holiday, the fireman, thinking to get an early start in the morning, filled the furnace with wood ready for lighting and in that condition left the place. It is supposed the wood took fire from the heat of the bricks from the previous firing, and that the safety valve had become stuck, preventing any release of steam. An idea of the wreck may be gained from the accompanying illustration. Two fragments of the boiler narrowly missed a train passing at the time. The crown of the boiler went through a barn a great distance from the scene, and the angle at which it struck the building showed that it must have been thrown at least half a mile high. In view of the terrible treatment received by the crown, at the hands of the steam fury, it is remarkable how gently it handled the window sash shown in the left foreground of the picture. This sash was used as a skylight, and was fixed in the roof right over the boiler. This sash was found after the explosion in the position shown, with not a single pane of glass broken. The mere concussion of air broke the glass in several houses near by, and how this window sash with all its contents passed through the explosion unshattered is a phenomenon. One theory is that it was lifted as on a cushion of steam, and so let down flat to the ground. Even so, its safe descent is remarkable, and how it was torn out of its frame, in the first place, without breaking the glass, is still more remarkable.

It is decided that Agincourt is to be the location of the instrument of the Magnetic Observatory now in the Queen's Park, Toronto. William Menzies will be in charge. The building to be erected will consist of a circular stone underground chamber of some 30 feet in diameter, topped by a brick structure for the making of absolute determinations. In the underground room, the needles of vertical force, horizontal force and the declinator will make photographic records of the earth's magnetic currents. The new building, it is estimated, will cost in the neighborhood of $4,000, and that the utmost care will be exercised in its erection can be seen from the fact that every stone put in the walls must be tested to ascertain that it contains no iron to disturb the delicate working of the magnetic instruments within.

Industrial Notes.

Belleville, Ont., will buy a road roller.

The new high school, at Fergus, Ont., will probably cost $5,000.

St. Thomas, Ont., will spend $36,000 on school buildings this summer.

The town of St. Cunegonde, Que., wants another bridge over the Lachine Canal.

Tenders are called for the Victoria Hospital, London, Ont., which is to cost $70,000.

A Y.M.C.A. building, to cost $6,000, is to be built in St. Catharines this summer.

Knox Church, Stratford, Ont., is to be altered and remodelled at a cost of $7,000.

R. F. Watts, Ottawa, Ont., is said to have invented a new roller boat which is rectangular in shape.

Sarnia, Ont., proposes to bonus a paving brick manufactory which would use shale from Alvinston, Ont.

Sheldon & Son, of the Aylmer, Ont., Iron Works, have received a large order for windmills from Australia.

J. Bloom, who ran a sawmill at North Glencoe, Ont., was killed by falling on the circular saw, March 31st.

The I.O.O.F. will build a town hall in Essex, Ont., one flat of which is to be leased by the town at $300 per year.

Lefebvre & Co., St. John's, Que., are putting an acetylene gas machine into their vinegar and canning factory.

Park, Blackwell & Co., Toronto, have decided to erect a new pork packing establishment. It will cost $100,000.

The city engineer of London, Ont., has proposed a dyke to surround the suburb of West London at a cost of $150,000.

The pumping plant at the high level reservoir, Montreal, requires a new large high duty pump, which will cost about $70,000.

The contract for the new Verity Company's buildings, Brantford, Ont., was let to Havill & Whitham, Brantford, for $50,750.

S. S. Jewett & Co., brass founders, Buffalo, N.Y., have no intention of establishing a brass foundry at St. Thomas, Ont., at present.

Ridgetown wants W. E. Hall's furniture factory to move there from Galt. It has been offered a bonus and exemption from taxation.

The Simpson-Merner Furniture Co., Berlin, Ont., of which Senator Merner is the head, will erect a large addition to its works this summer.

Extensive improvements are to be made in St. Andrew's Church, Perth, during the coming summer. It is estimated that $10,000 will be expended.

The Sarnia Gas & Electric Light Co. has closed a contract for a modern gas producing plant, with the Western Gas Construction Co., of Fort Wayne, Ind.

E. F. Head, architect, Rat Portage, Ont., has been instructed by the school board to prepare plans and specifications for a twelve room school building.

J. E. Belcher, C.E., County Engineer, Peterboro, Ont., has prepared plans for the Mudlake bridge, partly embankment and partly floating, to cost $25,000.

J. W. Meyers & Co., Listowel, Ont., have decided to make $7,000 improvements to their flour mill. They will also build an elevator, 30 x 48 feet, this summer.

The incorporators of the Dominion Aluminum Roofing Company, Montreal, are: Abel Huot, Lucien Girard, Antoine Collard and Nap. Plessis, contractors.

The Leviathian Belting Co., Boston, Mass., has opened an office in Quebec, at No. 101 St. John St., and has appointed L. H. Gaudrey as its representative in the district.

At Hartland, N.B., it has been decided to form a joint stock company to build a bridge. The government will be asked to guarantee the bonds for a term of 15 years.

Another pulp mill is to be built on the Sissaboo River, near Weymouth, N.S., as the Fredericton Reporter notes that a new company has been organized for the purpose.

The Ottawa Board of Trade has taken action that may soon lead to the establishment of a Technical School, in order to encourage the manufacturing industries of the city.

The Metallic Roofing Co., Toronto, has just supplied one of their metal ceilings for the chapel of the Central Prison. These goods are particularly adapted for church work.

The Rat Portage Lumber Co., of Rat Portage, Ont., is expending in the neighborhood of thirteen thousand dollars in special improvements on its planing mill, saw-mill, etc.

The London, Ont., water commissioners have decided to continue the conduit to Byron, so as to tap Griffith's springs, which will add 250,000 gallons per day to the city's water supply.

Two spans of the Saskatoon bridge on Qu'Appelle, Long Lake and Saskatchewan Railway, were carried away by ice April 19th. In the meantime crossing will be effected by ferry.

Dartmouth, N.S., has a proposition before it to bonus a pulp mill to have a capacity of 20 tons per day. The promoters have secured options on suitable water power and land in the town.

The Donoghue Bros., Kingston, will erect, on their property, near the Montreal Transportation Company's elevator, a grain elevator with a capacity of between 80,000 and 90,000 bushels.

M. A. Cleveland, who has a contract on the public works, Cardinal, is now starting in on his rock work, after placing an order with this same company for one of their latest model Sergeant drills.

F. G. B. Allen, supt. of the Cement works at Napanee Mills, Ont., has fitted up a laboratory in his residence. The office has also been moved to the station, the old office and laboratory turned into an engine room.

Some Ottawa people are looking for a suitable location and water power, to build a large pulp mill. If suitable site can be secured, with good shipping facilities, building operations will be commenced early this summer.

The respective county authorities of Norfolk and Simcoe, Ont., have decided to recommend that a new steel bridge, 150 feet long, be constructed over the Big Otter Creek, between the townships of Bayham and Middleton.

A man who has large experience in steel and iron manufacture, is coming out from England to take hold of Thos. Doherty's latest invention in that line, and will remain in Canada a couple of months at least, it is said.

The Manufacturers' Committee of the Brantford City Council propose a general exemption from all but school taxes, upon all machinery and tools for local manufacturing industries, employing a given number of hands.

The McClary Manufacturing Company, London, Ont., is filling an order from a San Francisco house for $7,000 worth of stoves, tin and graniteware, for the Yukon trade. The goods, which will fill six cars, will be shipped direct from London.

The Niagara Falls Metallic Furniture Company, Limited, has been incorporated with a capital of $24,000. The officers are as follows: Pres., R. P. Slater; Vice-pres., W. Phillips; Sec., J. E. Stephenson; Treas., Dr. E. T. Kellham; Manager, Wm. Hess.

W. Harris, Day's Mills, Algoma, Ont., offers power and mill-site free, with small bonus, to any responsible party who will erect any kind of wood-working, furniture or handle factory. Any amount of good hard wood and other timber near the site.

John F. Stewart, for many years manager of the James Stewart Manufacturing Company, Woodstock, has been succeeded by his brother, Adam A. Stewart. J. F. Stewart still retains his interest in the business, and the presidency of the company.

The James Cooper Mfg. Co., Limited, Montreal, has just completed shipment for Larkin & Sangster, contractors, Iroquois, Ont., of four Lidgerwood double cylinder, double drum hoisting engines, with five Sergeant drills, and quarry bar outfit.

The molders in the Waterloo Mfg. Co.'s foundry, struck recently for an advance of 25 cents per day; as no notice was given the management of dissatisfaction beforehand, the strikers did not receive any consideration, but were replaced by outside labor at once.

J. Zryd, G. Zryd, O. Zryd, J. E. Schmidt, Annie M. Zryd, Hespeler, Ont., have been incorporated as the Zryd Gas Machine Company, of Hespeler, Limited, to manufacture, buy, sell and deal in acetylene gas machines and parts thereof, capital, $5,000.

The village of Andover, N.B., has been recently incorporated and proposes to put in a fire protective waterworks system of 2¼ miles of piping. C. L. B. Miles, C.E., has been engaged to make the necessary surveys and plans. Tenders will be shortly called for.

L. McGlashan, manager of the Ontario Silver Works, Humberstone, Ont., intends making a large addition to the factory. The new wing will be about 100 x 40, brick. A large dynamo and gas engine will be among the plant to be placed in the new addition.

The Council of Westmount, Que., have passed the by-law authorizing the loan of $350,000, to be used in the construction of parks and other public improvements, among which are a contagious disease hospital to cost $15,000, a dump and incinerator to cost $10,000, and municipal buildings, $25,000.

The People's Heat & Light Co., of Halifax, is increasing their plant for greater facility in handling materials at the power house, and has placed an order with the James Cooper Mfg. Co., Montreal, for a standard Lidgerwood 30 horse power link motion and friction double drum cylinder hoisting engine, which will be shipped at once.

Andrew Bell, C.E., Almonte, Ont., on behalf of a company, has asked the Carleton Place town council for a franchise to put in a system of waterworks similar to the one in Perth, Ont. He wants a similar franchise for Almonte, and the company he represents is said to be willing to spend $100,000 in each town to put in a first-class system of waterworks.

The following have obtained incorporation under the style of the Jacques Cartier Pulp Company, to carry on the business of pulp and paper manufacturing; acquire water powers on the Jacques Cartier river and elsewhere, develop electricity to be supplied for motor and lighting purposes, etc., etc.: E. Goff Penny, R. Archer, Wm. Strachan, W. Currie and R. Law, Montreal.

The dynamite factory of the Ottawa Powder Co., situated on the Chelsea Road, on the Quebec side of the river, about four miles north of Ottawa, was recently blown up. No person was injured or killed. The damage to the plate glass in Ottawa amounted to over $2,000. The cause of the explosion is not known. This is the third time that the factory of the Ottawa Powder Co. has been blown up.

The Wm. Hamilton Mfg. Co., Peterboro, has in hand the entire equipment of a sawmill, which the C.P.R. is erecting at Cool Creek, about 60 miles west of McLeod, N.W.T., in the Douglas Fir District. The equipment of the mill is of the most modern type, and it will have a capacity of 100,000 feet in ten hours. The entire plant comes from the Hamilton shops, including a battery of six boilers, handsaws, etc.

James E. Smith, who at the time of the Windsor, N.S., fire, had charge of the reed and rattan department of the Windsor Furniture Mfg. Co., has entered into a partnership with H. B. Murphy, of the firm of Wood & Murphy, and will commence manufacturing reed and rattan goods. The factory will be in Falmouth, N.S., near the mill of F. H. Manning, who is now erecting a building, and will supply the new firm with power, water, etc.

The Dominion Plumbing and Supply Association was formed in Montreal recently, letters calling the meeting being sent out by Geo. Booth, of Toronto. The object of the association is for the better protection of the trade. The officers elected were: J. Reid Wilson, Montreal, president; A. A. McMichael, Toronto, vice-president; W. H. Wiggs, Quebec, second vice-president; while the Executive Committee will be formed of Col. F. Massey, W. Greig, A. Lariviere, J. M. Taylor and H. Wright.

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The Ontario Board of Health recently approved the plans for the village of Hintonburg, which is putting in a system of sewage; for Mount Forest and Port Colborne, which are putting in waterworks; and Rat Portage, which is also constructing waterworks and extending its sewage system.

The James Cooper Mfg. Co., Limited, Montreal, has just secured an order for an additional plant for the Regina Gold Mine, Limited, of Rat Portage, consisting of duplex cross compound condensing Ingersoll-Sergeant piston inlet compressor, ten drills, battery of boilers, pumps, heaters and all necessary connections to install plant complete. The first shipment in this contract has now gone forward.

Thompson & Co., Sherbrooke, Que., have agreed to install, in Lennoxville, a system of waterworks. The water will be taken from Haskell Hill, about half a mile distant. The reservoir will have a capacity of 400,000 gallons, and will be about 125 feet above the town. The contract will have to be finished within eight months from the date of the signing of the contract. There are to be twenty hydrants placed in the streets for fire purposes. A number will be placed in and about the buildings and grounds of Bishop's College.

The James Cooper Mfg. Co., of Montreal, has completed shipment of contract for complete mining plant entered into with the Montreal-London G. & S. Dev. Co., to equip the Dufferin property, at Salmon River, N.S. This plant consists of a duplex cross-compound condensing Ingersoll-Sergeant piston inlet air compressor, eight drills, battery of three boilers, one 50 horse power and one 40 horse power Lidgerwood link motion and friction double compartment shaft hoisting engines and all necessary piping and connections to install plant complete ready for operation.

Some important experiments were recently made in the Workman Engineering Building, at McGill University, by Profs. Adams and Nicholson, of the Faculty of Applied Science. They consist of taking filings or turnings of brass, copper, tin and other metals, and by means of pressure, securing therefrom solid bars of metal, differing very little in appearance and strength from castings. The machine used in these experiments brings to bear upon the filings and shavings about 78,000 lbs. pressure to the square inch, and this has the effect of welding them into a solid bar of metal.

The Canadian Photo-Engraving Bureau is extending its premises, having leased another flat in the building in which it is located, at 16 Adelaide St. West, Toronto, and is now making extensive alterations and improvements in it. Part of this extra flat will be used as an office, giving them greatly increased accommodation, and the balance as a photo department. It is their intention to establish a first-class photograph department, fully equipped for all kinds of commercial photography, such as landscapes, buildings, interiors (daylight or flashlight), and articles of any kind. The combination of the photograph gallery with the photo-engraving business, is a good one, and will be a great advantage to those having cuts to be made, where the photos have to be taken from the article or building.

Prof. Callendar, who has just resigned from the staff of McGill University, has designed a platinum electrical resistance thermometer, capable of measuring temperature to the ten thousandth part of a degree. The extreme delicacy of the instrument makes it a valuable aid in securing accurate observations of the temperature of lake and river water, during the various seasons of the year, as no thermometer is available for such minute measurements. A long series of observations of the temperature of the St. Lawrence has been made this winter by the McGill professors, in all of which the new instrument has been used. By its aid it has been found that the greatest deviation that takes place in the winter during the ice-forming period, is only about one thousandth part of a degree. Prof. Callendar's invention is, undoubtedly, of great interest to the scientific world.

The Wm. Hamilton Mfg. Co., Peterboro, Ont., has recently completed the engines for a large stern-wheel steamer, for J. A. Mara, Vancouver, B.C. The wheel is 19 feet in diameter with buckets 9 feet long, which take a dip of 30 to 34 inches; on either side of the wheel the cranks are placed. The crank shaft is a steel forging 10 inches in diameter and 24 feet long. The engines are aft on each side. The boiler is placed well forward, about 70 feet from the engines. The engines run 30 revolutions per minute, and the boiler pressure will be 160 lbs. The power developed is calculated at 2,300 h.p. Speed, 18 miles per hour. The cylinders are 17 inch and 6 foot stroke. The connecting rods are 24 feet from crosshead to the crank pin, and are built up of plates. From the head of the cylinders to the outside of the paddle wheel will be 48 feet. The boiler is of the locomotive type, 62 inches in diameter, by 7 feet long. In the barrel are 212 inch tubes, 14 ft. long. The furnace is 7 ft. by 5 ft. by 6 ft. high inside. The Hamilton Company has now in hand a duplicate set of these engines, building to the order of the C.P.R., for one of their boats running from Vancouver to Fort Wrangel.

Of interest to engineers throughout Canada is the advent of a new company known as the Canadian Chemical Compound Co. The principal promoters are A. M. Wickens, E. J. Philip, D. J. LeRoy and Richard Jeffrey, all of Toronto. The new company will manufacture boiler compounds, of which it has three special brands, suited for waters of different character. As the public may well be sceptical of the virtues of a patent medicine which claims to cure all diseases, so engineers may doubt the efficacy of any one boiler compound which claims to be suitable for waters of every locality. The Canadian Chemical Compound Co. not only has three different brands suited to the waters of most localities in Canada, but they undertake in exceptional cases to prepare special compounds where the water is heavily charged with any unusual foreign element. The three special brands will, however, remove scale from almost any class of water, and leave no injurious effect on the boilers. Messrs. Wickens and Philip have long made a study of this subject, and anything that they would place on the market will be received with confidence by steam engineers of Canada, among whom they are so well known. The new company has issued a very neat booklet, which will be sent free from its offices in the Temple Building, Toronto.

Electric Flashes.

The Vankleek Hill Electric Company, Limited, has received an Ontario charter for incorporation.

The electrical pumping plant in the Perth, Ont., waterworks is reported to be giving complete satisfaction.

The Canadian General Electric Co. has sold to Alex. Dobson, of Beaverton, Ont., a standard 20-K.W. Edison dynamo.

The Rathbun Co., Deseronto, is building a freight motor for the Longue Pointe section of the Montreal Island Belt Line Railway.

Larkin & Sangster, contractors, Iroquois, Ont., have purchased from the Canadian General Electric Co., a 35-light arc dynamo with lamps.

The Canadian General Electric Co. has put in the last of the four 4,000-light single-phase alternators ordered by the Toronto Electric Light Co.

The Halifax Tramway Company has installed two 5,000-light monocyclic alternators from the works of the Canadian General Electric Company.

The Canadian General Electric Co. is furnishing to the Linde British Refrigerating Co., Montreal, two 50 h.p. and one 15 h.p. Induction motors.

The British American Corporation, Vancouver, B.C., has ordered a 100-light dynamo, with search lights and engine, from the Canadian General Electric Co.

The Canadian General Electric Co. has closed a contract with the corporation of Port Arthur for a railway car body equipped with G.E. 1,000 motors.

The Consolidated Electric Co., Victoria, B.C., is preparing to develop a large amount of power at Goldstream near the city. The plant will cost about $100,000.

The B. C. Bullion Extracting Co. has made a contract with the Canadian General Electric Co. to supply a 100 horse-power synchronising motor, and a 50 horse-power induction motor for their works, which are about a mile and a half from Rossland, B.C.

An Electrical Engineers' Association for the maritime provinces was formed in Halifax last month. James Waddle, Charlottetown, P.E.I., was one of the delegates present.

The London, Ont., Electrical Construction Company is said to be willing to establish itself in Kingston, Ont., if exemption from taxes, free site and free water are granted.

The Canadian Pacific Navigation Co., Victoria, B.C., has purchased from the Canadian General Electric Co., for one of their steamers, a multipolar direct connected set with marble switchboard.

Price Bros., Quebec, have ordered from the Canadian General Electric Co. a complete electric and steam plant for the Assiniboine Block, Winnipeg, Man. The generating plant will have capacity for 400 lamps.

Hamilton City Council has voted to buy from the Hamilton, Chedoke & Ancaster Electric Ry. the Becket mountain drive and quarry for $12,000. This makes the construction of the road almost a certainty.

D. Maxwell & Sons, St. Mary's, are installing an electric plant for lighting their factories, and have purchased for the purpose a 350-light Edison dynamo, manufactured by the Canadian General Electric Co.

The Manitoba Gas & Electric Light Co., of Winnipeg, has ordered from the Canadian General Electric Co., a 6,000-light direct-current generator to run at 150 revolutions a minute, also a 125-light brush arc machine.

The Canadian General Electric Co. has closed a contract with the Laurentide Pulp Co., at Grande Mere, Que., for two 55-kilowatt moderate speed direct current dynamos with marble panels and instruments complete.

As announced in another column, the chair of electrical engineering, in McGill University, is vacant by the retirement of Prof. Carus-Wilson. Applications for the position will be received by the secretary up to 20th June.

Letters patent have been issued to the Toronto Electric Motor Company, Limited, capital $50,000. Those incorporated are: J. C. McLachlan, H. S. Albertson, G. McLachlan, J. W. Thompson and W. A. Turbayne, Toronto.

The Toronto Railway Company is refitting its long Yonge St. cars with G.E. No. 800, four-motor equipments furnished by the Canadian General Electric Company. The old two-motor equipments did not furnish enough tractive force.

The Peoples Electric Co., of Windsor, Ont., is making extensions to the electric system and has placed an order with the Canadian General Electric Co. for all the material required, including over 1,000-light capacity in transformers.

The Windsor Hotel Company, Montreal, is making extensive alterations in the electric installation, and has ordered from the Canadian General Electric Co. two 1,000-light slow-speed multipolar generators with marble switchboard panels.

The Montreal Street Railway Company has determined to construct the Cote des Neiges line, and the management is waiting the return of James Ross from England to commence operations, which it is expected will be by May 15th.

The authorities of the Longue Pointe Asylum, Montreal, are building a branch street railway to connect the institution with the Montreal Belt Line, and the Canadian General Electric Co. is supplying a 110 K.W. steel-frame railway generator to furnish power.

The London Electric Co. is putting in a 6,000-light 300 K.W. alternator to extend the sphere of their lighting operations, and two 160 K.W. direct-current, direct-connected generators for power. These machines are being supplied by the Canadian General Electric Co.

The Ingersoll Packing Company has contracted with the Canadian General Electric Co., Limited, for a complete installation of incandescent lamps, arc lamps, motors and generator for their factories at Ingersoll, Ont. The generating apparatus will consist of a 25-kilowatt 125-volt multipolar dynamo of the C.G.E. Co.'s latest and most approved type.

The Cataract Power Co., Hamilton, is making progress with its power development at Decew Falls. The works are expected to be completed in eight or ten weeks.

The Ontario Rolling Mill Co., Hamilton, is rapidly rebuilding the works recently destroyed by fire ; they intend installing the most modern system of electric lighting throughout, and have placed an order with the Canadian General Electric Co., for one of their latest types of multipolar direct current dynamos having a capacity for 300 lights.

W. Doherty & Co., Clinton, Ont., have commenced work on their new factories, which they expect to have completed early in May. The new works are to be lighted throughout by electricity, and for this purpose they have closed a contract with the Canadian General Electric Co. for a 500-light dynamo, two 10 h.p. motors, and all wiring material required.

The Hon. John Haggart, W. A. Allan, A. Charlebois, Sir Sanford Fleming and R. G. Code, of Ottawa, are applying for incorporation as the Canadian Electric Water & Power Co., of Ottawa, capital $10,000, to establish waterworks and manufacturing electric machinery and electricity for the purposes of light, heat and power in the cities and towns of Canada.

J. R. Scott, an enterprising citizen of Napanee, has closed a contract with the Canadian General Electric Co. for a 100 K.W., 4,000-volt, three-phase generator of the revolving field type, for the purpose of supplying light and power to Napanee from a water power 8 miles distant. He will also supply light and power to intermediate points such as Napanee mills, Camden East, and Newburgh.

The Montreal Cotton Co., of Valleyfield, Que., has just placed an order with the Canadian General Electric Co. for two 600 h.p. three-phase generators, to be direct connected to turbines. This installation is a duplicate of the generators installed by the C.G.E. Co. over a year ago, and which have given entire satisfaction. With these four generators and station apparatus the company will have one of the most modern power stations on the continent.

The Electric Reduction Co., of Buckingham, Que., is putting in a 1,000 h.p. three-phase generator for electrolytic work. This machine is wound for a potential of 60 volts, and is of the revolving field and stationary armature type. It runs at 160 revolutions per minute, 75 volts, and is direct connected to a water-wheel. The equipment is of the same type as that furnished by the Canadian General Electric Co. to the West Kootenay Power & Light Co.

The Hamilton and Lake Erie Power Co. has been given by the government the power to increase its capital stock from one to three million dollars, and extension of time for three and six years respectively to begin and complete the work. Hon. W. R. Scott appeared for the promoters, and said the works were costing a very large sum and an extension of capital was needed. When completed there would be a great reduction in the cost of power in that district.

The Hon. J. Lanctot, M.D., of St. Henri; A. G. Bourbonniere, A. Christin St. Amour, Montreal; L. A. Sauve, St. Ignace du Coteau du Lac, and A. McNown, Cornwall, have applied for incorporation under the name of "La Compagnie d'Electricite de Soulanges." The object of the proposed company is to operate telegraph and telephone lines in the county of Soulanges, with a capital stock of ten thousand dollars. The principal place of business will be at Coteau Landing.

The Manitoba Gas & Electric Co., Winnipeg, is making very extensive alterations and additions to its plant, and have placed an order with the Canadian General Electric Co. for a 300-kilowatt alternating generator of their monocylic design, and one 125-light brush arc dynamo to be direct connected to vertical engine.. The Canadian General Electric Co. is thoroughly overhauling the outside construction work, and equipping the system with their standard type H. transformers throughout.

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L. A. Campbell, for several years chief engineer of the Canadian General Electric Company, has been appointed general manager and electrical engineer of the West Kootenay Power and Light Company. Under the superintendence of Mr. Campbell, this company has already installed 2,000 horse power for delivery to Rossland, B.C., and has a waterway developed for 7,000 horse power altogether. The company supplies power to the celebrated War Eagle mine, whose plant is referred to elsewhere in this issue.

At a meeting of the Royal Electric Engineering Society, held a short time ago, K. B. Thornton, of the Royal Electric Co., read a paper on Alternating Current Arc Lamps; also at a meeting of the society, held March 31st, W. F. McLaren and R. F. Morkill, of the Royal Electric Works, read a paper on Alternating Current Motors. Mr. Dix, of the same Company, will read a paper at the next meeting, April 14th. The society are holding their meetings in the Board Room at the Royal Electric Co.'s General Offices, which has been very kindly loaned by Mr. W. H. Browne.

It will be remembered that in the action taken by the Montreal Street Railway Company against the Montreal Park & Island Railway Company, on account of loss from the fire at the exhibition ground buildings, when a number of cars leased by the Street Railway Company to the Park & Island Company were destroyed, the Superior Court granted the Street Railway Company $5,786 damages. From that judgment there were two appeals, one from the Street Railway Company itself, claiming that the amount granted was too small, and another from the Park & Island Company, asking that the action be dismissed. The Court of Appeal held that there had been no fault or negligence on the part of the Park & Island Railway Company or its employees and the damage to the cars had been caused by an irresistible cause. Under those circumstances the judgment of the court below must be reversed, and the action of the Street Railway Company must be dismissed.

The Toronto Electric Motor Company's business has again out-grown its premises, though two or three extensions have been made since it was established in Adelaide St. The Company is now building a factory of its own in Pearl St., and expects to move into its new premises in the course of a month. Among the orders awaiting delivery on the books are 100 arc lamps, for the Citizens' Light and Power Co., Montreal; a 5 horse power motor for T. H. Dryden, Toronto, and one of similar size for R. Anderson, Ottawa; two 30 horse power motors for the Mail and Empire, a 30 k.w. generator for the elevator at Coteau Landing (owned by John S. Metcalfe & Co., Chicago), a 60 k.w. generator for R. E. T. Pringle, Montreal, and a 130 k.w. generator, and a 140 horse power motor for the T. Eaton Company, Toronto, the last-named being the sixteenth machine furnished by this firm to the great departmental store. Another interesting installation is a 200-light dynamo and a 20 k.w. power generator for the Rat Portage Lumber Company, to be used for lighting the mills and for operating an electric locomotive for a tramway running throughout the Company's yard.

Mining Matters.

The Dominion Coal Co. is building a large number of cars.

Oil is reported in the township of Brooke, near Alvinston, Ont.

The Canadian Mining Institute has applied for a Dominion charter of incorporation.

Another oil well at Point Edward, Ont., is completed, and its pumping qualities tested with satisfactory results.

The Hamilton Board of Trade has asked the Dominion Government to impose an export duty on nickel ore.

The British Columbia Smelting & Refining Co. has transferred the smelter at Trail, B.C., to the C.P.R. Company.

The Iron Mask Mine, Rossland, B.C., is putting in one of the Jenckes Machine Co.'s smaller size hoisting engines.

The discovery of an extensive deposit of valuable iron ore is reported to be made in the Laurentides, about eighty miles from Montreal, on property owned by Adolph Trempe, brother of the Montreal detective of that name.

British Columbia business still continues brisk. The Jenckes Machine Co. reports the demand for mining machinery quite active.

The Rossland branch of the Jenckes Machine Co. recently placed a No. 5 Cameron pump with the Center Star Mine, also a No. 6 with the Monte Cristo.

The Dominion Government has authorized the issue of free miners' licenses at the summits of the Chilcoot and White passes, at the head of Lynn Canal.

The receipts from the corporation natural gas plant last year in Leamington, Ont., were $10,406.14, and the expenses in connection with the plant were $770.

Large coal beds are said to have been located on or near the line of the proposed Glenora and Teslin Lake Railway, about fifty miles from Telegraph Creek.

The Boundary Creek District, of British Columbia, is coming forward, and it is very likely that a number of large development plants will be put in during the coming season.

E. E. Pettigrew, of Winnipeg, has placed an order with the Jenckes Machine Co., Sherbrooke, for a five-stamp mill complete, with thirty-five horse power engine and portable boiler.

The property of the Non-Magnetic Asbestos Co., of Point au Chene, Que., is advertised for sale in another column; the sale to take place on the 15th. The property is reported to be a very valuable one.

The Canadian Rand Drill Company has sold to R. O. Jennings, Fort Steele, B.C., a big power pump for use in the hydraulic mining plant which the Jennings Company is installing on Brewery Creek.

Texada Islands, off Jervis Inlet, B.C., will, it is said, soon have a smelter. The plant was ordered by the Van Anda Company, which has brought ten cold-copper properties on Texada to an advanced stage of development.

The Kenneth Mining and Development Co., at Rossland, B.C., is making an addition to its equipment in the shape of a 7 x 10 double-cylinder hoisting engine, with boiler and all appliances complete, furnished by the Jenckes Machine Co.

Vivian & Sons, Swansea, Wales, and the Elbois Metal Company, of Burryport, South Wales, have, it is said, as the result of the success of trials, decided to come into the British Columbia market for the purpose of smelting all kinds of ore and furnace products.

John Fenton, farmer, who lives near Ryckman's Corners, Ont., has had natural gas on his farm for several years, sufficient to heat and light the house, and recently a big flow of gas was struck at a depth of 200 feet. The previous flow was from a well 460 feet deep.

The Brookfield Mining Co., North Brookfield, N.S., has bought a hoisting engine and other machinery from Austen Bros., for use on the Dunbrack property, recently purchased by them. They propose to sink a shaft about 200 feet and then drive levels to thoroughly test the belt.

Development still continues on the Golden Cache Mine, Rossland, B.C. The company claim to have a narrow claim streak, running $200, with the rest of the ledge containing average values to pay $1 net. Contracts, amounting to $40,000, have been let for electric and hydraulic plants.

The Electric Reduction Co., of Buckingham, Que., is proceeding to develop the water-power, and as a first step has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a pair of 45" crocker turbines, to be installed complete with wheel cases, draft-tubes, governor, etc.

The emery found on the East shore of Lake Winnipeg has been pronounced by experts to be of the very finest quality. The deposits are known to extend over an area of twenty-five square miles. About 50 claims have been taken up. Deposits of aluminum and quicksilver have also, it is said, been found.

The proposed British Columbia Chamber of Mines has been established. The initial meeting was held at Vancouver, B.C., with Dr. Selwyn, F.R.S., in the chair, and representatives of mining interests from different districts present. Twenty-five signed as representative and five as associate members. The following were elected an executive committee: W. A. Carlyle, W. Pellew Harvey, W. White, H. Abbott, H. Cohen, Barclay Bonthrone, A. St. G. Hamersley, F. S. Taggart, C. C. Bennett, Dr. Selwyn and Dr. Bell-Irving.

The B. C. Goldfields Co., of Toronto, has recently placed an extensive order with the Jenckes Machine Co., for a ten-stamp battery complete with two vanners, two ore feeders, grizzly, Blake-Marsden crusher, and all the various apparatus making up a complete modern milling plant. The outfit is to be delivered at Nelson, B.C.

The British Columbia Copper Co., Anaconda, B.C., have just contracted with the James Cooper Mfg. Co., Limited, Montreal, for the installation of an Ingersoll-Sergeant ten-drill compressor plant, complete with ten drills, battery of boilers, Lidgerwood hoisting engines, pumps, heaters, and all necessary equipment to make the plant complete.

Dr. J. B. Porter, Professor of Mineralogy at McGill, is now in the mining regions of Nova Scotia, at the head of a large field prospector's class from McGill University. They will examine portions of Cape Breton, and the Guysborough gold fields, remaining in the east about six weeks. The class was sent out through the generosity of W. C. McDonald.

Dr. Gilpin, inspector of Nova Scotia mines, has sent to the Provincial Government a report on the result of his recent official trip to Whycocomagh Cape Breton. He says the gold discoveries are very valuable but does not go into minute details. Dr. Gilpin found very rich quartz and also free gold in sand taken from the bed of the Whycocomagh River.

The annual report of the B. C. Dept. of Mines has been presented to the Legislature. It shows that the total output of minerals, including coal, in 1897, was valued at $10,455,268, an increase of 40 per cent. over the previous year's yield. The gold value was $2,646,000; silver, $3,272,000; lead, $1,390,000.17; coal, $2,648,562. West Kootenay produced to the value of $6,765,000.

An oil well has been struck on the farm of Benjamin Boothroyd, about a mile from Thamesville, Ont. F. Carmen is the proprietor of the well. One night there were two hundred barrels pumped in twelve hours, and the average yield is still almost equal to that. There is another well on the adjoining farm, the property of John Herbert, which promises to be almost equal.

An Edmonton despatch says that letters to Rev. Father Husson and R. Hardisty confirm the report that "Cayuse" Graham has come across the mountains from the head waters of the Pelly River, and has struck pay dirt at ten to twenty dollars a day. Graham crossed the Upper Liard, west of the mountains, in November, and reached Fort St. John on February 1st, with horses and sleds.

A letter recently received by Bishop Pascal, of Prince Albert, from Rev. Father Ancel, stationed at Hay River Mission, in the North-West Territories, states that a party of prospectors have found rich gold deposits on both Hay and Buffalo rivers, emptying into Great Slave Lake. These rivers are located about 700 miles north of Prince Albert on the Regina and Prince Albert route to the Klondyke.

F. C. Flannery, secretary-treasurer of the Toronto Smelting Company, proposes erecting at Madoc, Ont., a plant to treat the mispickel ores of Hastings County; he recently showed samples of the arsenic produced at the company's small test-mill at Millbridge, Ont. The company has now a ten ton water jacket smelter, which is to be put up at Madoc, and started as soon as possible. The company will treat the mispickel ores for arsenic with gold and mineral wool as bi-products.

Free mining machinery to the value of $128,780 was admitted into Canada during the fiscal year ended 30th June last, having been supplied by the following countries: Great Britain, $9,266; Denmark, $2,451; Germany, $2,864, and the United States, $114,239. Of this amount Ontario got $30,308; Quebec, $24,812; Nova Scotia, $21,520; New Brunswick, $452; Manitoba, $695; British Columbia, $44,087, and the Northwest Territories, $5,897. In addition to these should be mentioned diamond drills purchased in the United States of a value of $19,880. Among the dutiable articles we find 184 steam pumps, valued for duty at $24,860.

MOVING TIME! Subscribers are reminded to notify us of any change in address necessary Give both old and new addresses.

THE PUBLISHERS.

Marine News.

The contract for repairs to the steamer Rosedale was awarded the Caledonia Iron Works, Montreal. The repairs will amount to about $28,000.

The Geological Survey of the United States has ordered a large number of canoes from the Peterboro Canoe Company for the use of exploring parties in Alaska.

The propeller Persia has been bought by W. A. Geddes, Toronto, and Jacques, Montreal, Capt. Crangle and J. H. G. Hagarty having sold to those gentlemen their interest.

Clinton B. Sears is considering the matter of raising the bones of the old steamer Winnipeg, of the Collingwood line, which lie in shallow water at the bottom of Duluth harbor.

The Canadian General Electric Co is equipping, with incandescent light, a steamer being built by the British Columbia Iron Works, for the Klondyke Exploration Co., Limited.

The Canadian Pacific Navigation Co. has purchased from the Canadian General Electric Co., a 125-light, incandescent plant for a steamer running from Vancouver to the Stikine River.

The British Columbia Iron Works Co. has ordered a 6-kilowatt incandescent dynamo from the Canadian General Electric Co., for a steamer which it is building for the Klondyke trade.

The Canadian Development Co., Victoria, B.C., of which H. Maitland Kersey is Managing Director, has ordered three incandescent light equipments, for new steamers, from the Canadian General Electric Co.

The Hudson Bay Company has placed a contract with the Canadian General Electric Co. for two 100-light incandescent equipments, to go on their new steamers, running from Vancouver and Victoria to the Stikine River.

Messrs. Cameron, Collingwood and Burton, of Barrie, have arranged to place the City of Collingwood and the Majestic on the route between Collingwood, Owen Sound, Sault Ste. Marie, Port Arthur, Fort William and Duluth.

The Allan Line has given a contract for the construction of a ten thousand ton steamer, to be known as the "Sicilian" and a sister ship to be the "Tunisian." The length is five hundred feet, beam 60 feet, speed sixteen knots, capacity 1,050 passengers.

The directors of the Richelieu and Ontario Navigation Company have appointed a new official, to be known as inspector of stewards. H. Bonchard, who has been in the employment of the company for 17 years, has received the appointment, with headquarters at Montreal.

J. A. Mara, late member of parliament for Yale and Kootenay, is building a river steamer at Vancouver for the Yukon traffic. She is said to be the largest boat that will be employed on the rivers up North, being 520 feet long, 32 feet beam, 5½ feet depth of hold, and will cost in the neighborhood of $25,000.

The Canadian General Electric Co. has a contract for supplying three direct-connected units for the C.P.R. steamers which are to go on the Stikine route. These units will consist of a 4-kilowatt, 70-light incandescent dynamo, direct-connected to a vertical high-speed engine, running at 606 revolutions per minute.

W. Bell Dawson, engineer in charge of Tidal Survey, has this year issued, in neat pamphlet form, Tide Tables for Charlottetown, Pictou and St. Paul Island, C.B., for 1898, with Tidal Differences for Northumberland Strait, and for the open Gulf shore, from Miramichi along the north coast of Prince Edward Island.

The Canadian General Electric Co. is installing a Direct Connected Lighting unit on board the C.P.R. steamship Athabasca, consisting of a 500-light incandescent dynamo, direct connected to a 50 h.p. high speed "Ideal" engine. This unit, which is very compact, occupies a floor space of less than 6 ft. x 9 ft. The dynamo is of the latest steel frame multipolar type, with ventilated armature. A marble switchboard, on which are mounted a standard equipment of instruments, is also part of the new equipment, which when finished will be the most complete on any of the steamers now running on the upper lakes.

Capt. Crawford will again this year be Commodore of the Hamilton Steamboat Company's fleet. He will sail the Macassa in the spring and fall and the Modjeska during the busy season. Capt. Maddicks will be in command of the Macassa while Capt. Crawford is on the Modjeska.

The total number of casualties to British and Canadian sea-going vessels in Canadian waters, and to Canadian sea-going vessels in waters other than those of Canada during the year, as stated in the report to Parliament, of the Dept. of Marine, was two hundred and thirteen, representing a tonnage of 80,317 tons register, and the amount of loss, both partial and total, to vessels and cargoes, as far as ascertained, was $718,293. The number of casualties to inland vessels was twenty-seven, tonnage, 5,726; loss, $48,350. The number of lives reported lost in connection with these casualties was thirty-four.

The following candidates, recently examined by W. L. Waring, St. John, N.B., have passed and will be granted marine certificates: Geo. H. Waring, jr., of St. John, second engineer of Prince Rupert, chief engineer's certificate, valid in Great Britain; Fred. John Lewis, of St. John, second-class certificate, valid in Great Britain; Charles Helman Hanson, of Chatham, third-class certificate; Geo. Frederick McRoberts, of St. Andrews, fourth-class certificate; George Herbert Burpee, Sheffield, Sunbury County, fourth-class certificate.

The Manhattan Steamship Company was incorporated Jan., 1898, with a capital of $1,000,000, with the following directors: J. J. Hillman, Philadelphia, president; Jos. D. Huggins, New York, vice-president; N. L. Newcomb, New York, general mgr.; H. E. Alexander, Wm. F. Weiss, Thos. W. Buck, Roland F. Hill, Tunis G. Bergen, New York; Isaac C. Ogden, Orange, N.J.; Beverley S. Reed, Boston; C. Everett Evans, Taunton, Mass. The offices of the company are at 11 Broadway, New York. Contracts have been given for the construction of three steel twin screw passenger and freight steamers. The dimensions of these steamers are 250 feet long by 45 feet beam. Each of these steamers contains two engines, 22 x 36 x 55 x 28 inch stroke; six boilers, 11 feet 6 inches in diameter by 12 feet 6 inches long, giving a sea speed of 17 knots per hour. These steamers are of the most modern construction, with large space devoted to cold storage. The company will operate a steamship service between New York, Maine and the maritime provinces. Pier No. 1, North River, New York, has been leased at a rental of $35,000 a year for a period of ten years.

Considerable discussion is going on in marine circles in St. John, N.B., on the subject of marine engineers' permits. The regularly qualified engineers are not satisfied with the present system of granting such permits, and claim that there are many inconsistencies in the laws with regard to granting papers to men to make them marine engineers and in the rulings of the men who are in power to grant the papers. The engineers who study the laws, say that a fourth class engineer, who is compelled to have certain machine-shop experience, and also experience in the engineering of a steamboat, is not permitted to take charge of the machinery of any passenger boat, and the man who holds the permit has not to have all these qualifications and can run any passenger boat of nine-horse power. The act provides that a temporary certificate may be granted and be in force for a term not exceeding one year to an applicant "sufficiently qualified by his knowledge of steamboat machinery, and his experience as engineer on a steamboat, authorizing him to act as an engineer of a steamboat carrying passengers, having an engine of not more than four nominal horse power if the engine is a single cylinder engine, or nine nominal horse power if the engine is of the compound type.

Everything in the marine line is rushing at Gravenhurst, Ont., "We had the launch of a new steamer built last winter for Homer & Co., of this town," writes a correspondent. "She is 65 feet long, 14 feet beam, 6 foot hold. She is built all of oak timber, and calculates for a passenger steamer will carry 130 passengers. Her speed is 12 miles an hour. She was built by Davis & Sons, Kingston. The same firm have a contract to enlarge the steamer "Kenozha," for the Muskoka Nav. Co. They are adding 18 feet to her length, making her 126 feet long. There will be new cabins, 56 feet long, built on the promenade deck, besides new pilot house, and captain rooms on the hurricane deck. Her rebuilding will cost $3,000, and is to be ready for work by June first."

Railway Matters.

The Quebec Central Railway is making extensive additions and improvements at the car shops in Newington. A new engine house, with a capacity of ten engines, has been erected.

The Grand Trunk will lay 120 miles of new track this summer between Niagara Falls, Sarnia and Windsor. The new rails will weigh 80 pounds to the yard; that which is down at present weighs from 56 to 66 pounds.

The managers of the Ottawa & Parry Sound R. R. have purchased sixteen new mogul engines in anticipation of a great increase in the grain business. They are ten-wheelers, and weigh 156,000 pounds each, without the tender or water in the boilers.

The Grand Trunk Railway Company will move the head offices of two branches of the construction work to Toronto. General Roadmaster Ferguson will be established here with his staff, and offices are also being prepared for the superintendent of bridges.

Both the G.T.R. and C.P.R. are introducing a new code of lamp signals to use on their freight trains. In addition to the usual tail lamps there will be an extra large one placed on the top of the conductor's van, and will be known as the copula lamp. This lamp will be an extra safe-guard against rear accidents. The engineer will also be in better communication with the end of the train.

Sir William Van Horne, at the annual meeting of the C.P.R. shareholders, remarked, in connection with the double-tracking of the Montreal-Toronto line, that it is ultimately intended to double track from Port Arthur to Winnipeg, and from Montreal to Farnham, and steps had already been taken in that direction, but the Montreal-Toronto section was regarded as the most urgent.

The following new appointments on the Canada Atlantic Railway went into effect recently. Mr. C. J. Smith is now general traffic manager; Mr. J. E. Walsh has been appointed assistant general passenger agent; Mr. W. P. Hinton has been appointed assistant general freight agent. These officers will have their headquarters at Ottawa, where the general offices of this company are located. Mr. M. A. Overend has been appointed foreign freight agent, with headquarters at 115 Board of Trade Building, Montreal.

Premier Greenway's Manitoba Ry. scheme includes 80 miles south-east from Winnipeg towards Lake of the Woods, upon which a guarantee of $8,000 per mile is given, controls rates secured as on the Dauphin railway, also large reductions on cordwood and sawlogs, which, it is believed, will bring the mill to Winnipeg. Next year arrangements will be made to connect the line with the Rainy River railway, and thus secure the road to Lake Superior, with a ten-cent rate scheme; also includes extending the Dauphin railway 140 miles north to the Saskatchewan River, through the fertile Swan River valley; also on a guarantee of $8,000 per mile, the government being secured by a first mortgage on the road. This will be half way to Hudson's Bay.

In the case of P. Hannaford v. the G.T.R., the plaintiff claims a year's salary ($6,000), in lieu of notice, and claims that his discharge was without cause and illegal, putting in evidence a letter from Sir Charles Rivers-Wilson, in which it was stated that nothing but absolute necessity caused the directors to dispense with Mr. Hannaford's "valuable" services. The company, on the contrary, claim that Mr. Hannaford had used his position for purposes other than the interests of the company; that he had employed servants of the company to do work for himself; that he had promoted his son without getting the approval of the general manager of the company to the promotion, and that, in any case, he knew of and approved an agreement signed by the employes of the road to accept a month's warning at any time. Strong evidence was given by several employees that they had done work for Mr. Hannaford on his private residence, both in time and with materials paid for by the company.

Word has been received at Kincardine, Ont., of the death of L. B. Hamlin, C.E., formerly, it is said, resident of that town. Mr. Hamlin was county engineer of Bruce for some years. He was engaged on the Government service in the Yukon country, and was frozen to death in the Klondyke.

Personal.

W. J. Harkom, Montreal, is appointed assistant to the mechanical superintendent of the C.P.R.

The death of Captain Campbell occurred on the S.S. "Lake Ontario" on Saturday, April 2.

Geo. Booth, Toronto, was elected treasurer of the Canadian Manufacturers' Association at the recent annual meeting.

D. J. Macdonald, B.C. Provincial Mine Inspector, resigned his position on April 10. He has taken a position with a mining company and will reside in Rossland.

James Warren, C.E., Walkerton, Ont., has been appointed town engineer for Waterloo, Ont. The town is without a map, and the first thing Mr. Warren will have to do is to make one.

The Chatham city council has appointed Charles Topp, C.E., of Bracebridge, city engineer. The salary will be $1,000, and the present waterworks engineer's services will be dispensed with, it is said.

At London, Ont., April 11th, Miss Mary Rolston was married to Samuel Break, general manager of the London Electrical Construction Company, and formerly superintendent of the London Street Railway.

J. A. Sheedy, of the Illinois Bridge Works, Chicago, Ill., has been appointed master of bridges and buildings on the Grand Trunk Railway system, in place of William Crawford, of London, Ont., resigned.

T. E. McLelan, manager of the Berlin and Waterloo Street Railway, has resigned his position to go to the Klondyke. He will be succeeded by Hedley H. Hilborn, of Montreal, who has been in the service of the Montreal Street Railway.

H. B. Spencer has been appointed superintendent of the Eastern division of the C.P.R. and the Montreal-Ottawa line, with headquarters at Ottawa. J. E. A. Robillard, the former superintendent, will have charge of the Labelle and St. Jerome branch of the C.P.R.

P. A. Dickson, aged 40, died at Brantford, April 24th. He was for a number of years electrician for the Brantford Electric Power Company, leaving there last summer for British Columbia, where he contracted a severe cold, which resulted in his death.

Mons. Ephrem Valiquet, who has just been elected president of L'Association De Secours Mutuels des Ingenieurs Mecaniciens, was presented by W. Rutherford & Sons with a handsome silver jug as a token of respect on the occasion of his leaving their employ to become foreman for Lymburner & Mathews, of Montreal.

William Wilson, engineer of the S.S. "Alert," died suddenly a short time ago, he having, up to the hour of his death, been in perfect health. He was a native of Glasgow, Scotland, and came to St. John's, Nfld., 37 years ago, as engineer to Baine Johnstone & Co ; since then he has been with Bowring Bros., in the Tug Co., and for the past 11 years an employee of Job Bros.

Prof. Hugh L. Callendar, F.R.S., of McGill University, has been appointed to the Quain professorship of physics at University College, London, vacated by the resignation of Professor Carey-Foster. The friends of Professor Callendar cannot but be pleased at his appointment to what is considered a leading professorship in England, but there is not so much rejoicing at McGill, where his talents will be greatly missed. When accepting Prof. Callendar's resignation the McGill Faculties of Arts and Applied Science unanimously passed a resolution of regret in which they expressed their appreciation of his great merit and ability.

John Watson, the well-known stationary engineer, died recently at his home in Montreal. Mr. Watson was born in Edinburgh, Scotland, seventy-eight years ago, and came to Montreal when about twenty-six years of age. He was for a number of years employed by the Grand Trunk Railway, and had the distinction of making one of the party that accompanied the first engine run over the line to Lachine. Afterwards he went into business for himself as a machinist on Chenneville street, and later was in partnership with his brother, the late Thomas Watson. When the new post-office was built he accepted the position of engineer there, where he was up till about four years ago.

The harbor master of Montreal, Captain Thos. Howard, who died recently at his home in that city, was born at Shinroan, Queen's County, Ireland, on September 15, 1826, and came to Canada in 1842. For a time after his arrival he was in the employ of the late Hon. John Hamilton, and later on entered the service of the Richelieu & Ontario Navigation Company. For some years he commanded the "Banshee," "St. Lawrence," and other vessels of the company plying between Montreal and Western ports, and was subsequently appointed manager of the Ontario division of the company. In March, 1881, he was appointed harbor master at Montreal, a position which he held until the day of his death.

Prof. C. A. Carus-Wilson has announced his intention of resigning the chair of Electrical Engineering at McGill University on September 1. He came to Montreal in 1890, having been previously on the staff of the Royal College of Engineering, Cooper's Hill, England. His resignation will be a great loss to McGill College. His future permanent address will be "Hanover Lodge, Kensington Park, London W., England." During May, Prof. Carus-Wilson will give the Cantor lectures on electric locomotives at the Society of Arts, London, and throughout the summer he proposes to devote special attention to electric railways, a subject of great and increasing importance in England now. The volume on electro-dynamics which he has written for Messrs. Longmans, Green & Co. (London and New York), will be published at once.

Chauncey M. Depew retired from the presidency of the New York Central on April 20th and was succeeded by S. R. Callaway. Mr. Callaway is a Canadian, entering the office of Mr. Hickson at Montreal in 1863, when 13 years of age. In 1865 he went as secretary to Gilman Cheney, manager of the Canadian Express Company, and left there in 1869 to enter the service of the Great Western Railway under W. Wallace, the superintendent at London, and subsequently private secretary to W. K. Muir at Hamilton. Mr. Callaway retired from the Great Western to enter the service of the Detroit and Milwaukee, of which road he was superintendent from 1875 to 1878. Upon the absorption of the D. & M. Railway by the Great Western Mr. Callaway was appointed general superintendent of the Detroit and Bay City Railway, and in 1880 general manager of the Chicago and Grand Trunk and president of the Western Indiana railways. In 1884 Mr. Callaway accepted the position of vice-president and general manager of the Union Pacific Railway and the allied lines of nearly 6,000 miles. In 1887 he was elected president of the Toledo, St. Louis and Kansas City Railway, and since then he left that road to accept the presidency of the Lake Shore and Michigan Southern Railway.

FIRES OF THE MONTH.

April 1st.—The Sine Creamery, Sine P.O., Ont., destroyed.——April 2nd.—Geo. H. Hees, Sons & Co., window shade factory, Davenport Road, Toronto. Loss, $40,000, being rebuilt.——April 8th.—G. W. Green's wood-working factory, Ashburnham, Ont. Loss, $8,000 ; insurance, $4,500.——April 8th.—Lebel & Wilson's Lead Works, London, Ont. Loss, $4,000.——April 11th.—Chadwick Bros., Hamilton, metal spinning shop. Damages about $200.——April 13th.—F. Routhier & Sons, foundry, Vankleek Hill, Ont. Loss, $3,000 ; insurance, $1,000.——April 13th.—Small saw mill, Newbury Junction, N.B. (Jas. Carr, Woodstock, N B., proprietor). Loss, $2,000.——April 19th.—Doan's tannery, Clinton, fire starting in the boiler room. Total loss.——April 19th.—Ore house at the Payne mine, Nelson, B.C. Loss, $10,000.——April 19th.—Gaw's planing mill, Place D'Armes, Kingston, Ont. Loss, $12,000 ; insurance, $5,000.——April 23rd.—The cupola of Wortman & Ward's foundry, London, Ont. Damages, $500.——April 30th.—The Rathbun Co.'s terra cotta works, at Deseronto, Ont., plant destroyed. Loss about $100,000 ; partially iusured.——May 1st.—Jas. McLatchie's machine shop, Cardinal, Ont Loss about $5,000.

IMPULSE WATER WHEELS.*

By J. T. Farmer, Ma.E.

The development of power by means of impulse water wheels, has been receiving considerable attention during the past ten years. Water power is to be met with under varying conditions and in various surroundings; and the means best adapted for the utilization of the power vary with those conditions and surroundings.

Among the means devised by man at different times before the advent of the impulse wheel for utilizing the water power that was going to waste around him, one has easily taken the foremost place, and, indeed, has, by a process of the survival of the fittest, practically ousted all other methods from a position of being worthy of serious consideration. The turbine has at the present day almost entirely taken the place of the earlier devices in use, which have either been consigned to museums as curiosities or are regarded as picturesque additions to the landscape.

The impulse water wheel probably differs as much from the various forms of turbine in construction and in action as the turbine does from an overshot or breast water wheel. The previous statement with regard to the turbine must therefore be further modified so far as it is found that the impulse motor is finding favor with those who utilize water power.

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*From a Paper read before the Canadian Society of Civil Engineers.

It has been said that "countless wealth is being squandered in all the torrents and water courses of the world." But it might be added that unless the proper means are taken for its utilization, wealth of energy avails little more to man than that of the tides of Jupiter.

It seems at first sight a very simple matter to place a wheel in position to take up the energy of water; but in practice that arrangement is generally found to involve more or less costly construction in the way of dams, basins, canals, flumes and even tunnels. This is particularly the case where the use of turbines is contemplated, and this consideration is frequently sufficient to annihilate the expediency of thus attempting to utilize a known and otherwise available source of power.

These adverse conditions are forcibly illustrated in the mountainous districts of the North American Continent. Water power is there in abundance, but it is that of mountain torrents: as a rule inconsiderable in volume of water, but, on account of the configuration of the country, affording large heads. The latter circumstance makes any constructive work very costly, and in most instances would put the use of an ordinary turbine out of the question.

It was from such causes that the Western States became the birthplace of that system of water power of which the essential feature is an impulse water wheel. The simplification made possible in this system is that of the substitution of a pipe and nozzle of insignificant dimensions for the massive head race and wheel pit associated with the use of a turbine.

The first impulse wheels brought into use were of the very crudest description; with the increasing use of the system, however, came the development which attends every invention which has a large field of usefulness open to it. The impulse wheel of the present day ranks as fairly efficient among the various means of utilizing natural energy.

At this stage it becomes a question to what extent it may be desirable to employ the impulse wheel outside the conditions under which it first sprang into existence. This problem is specially interesting in a country where there is an abundance of water power, and at a time when the utilization of water power is assuming the place of one of the most important engineering questions of the day. The object of this paper is to record the results of some experimental research on this subject, and also to discuss the question by the light of those results and from other considerations.

The history of the development of the impulse water wheel may advantageously be sketched briefly. The first wheels of this class were simply provided with flat projections on the rim of the wheel, and the jet was arranged to impinge normally on these flat surfaces. This was what was known as the hurdy-gurdy. It can easily be shown from theoretical considerations that the ideal efficiency of such a wheel is 50 per cent., but it is probable that most of those in use did not give a greater efficiency than from 20 to 30 per cent.

The first notable improvement was that of substituting hollow cups for the flat vanes, so that the jet struck the interior part of the cup and was deflected back again until it left the vane, traveling, with respect to the vane, in almost the opposite direction to that in which it was traveling before impact. This formation at once largely increased the efficiency, but in practice the efficiency was still far from what it theoretically might be.

The next modification was that of so curving the surface of the cup that the jet might follow the surface with very little deviation at the first point of contact. Thus some wheels are formed with a conical projection in the interior of the cup at the point where the jet strikes the surface, so that the water on striking may begin to pass along the generating lines of the cove, and may gradually be deflected further to follow the curved sides of the interior of the vane. The more common construction is to place a wedge-shaped projection across the interior of the cup or vane. This modification was introduced about 1880. The function of the wedge is two-fold.

(1) To prevent the heaping of dead water upon the vane during its passage through the arc of action, or the part of its path in which the vane receives the jet of water. (2) To give the diverted streams a direction of motion which will finally carry them clear of the wheel.

In a bucket unprovided with any conical or wedge-shaped projection, there is no sudden angular deflection of the water. Some of the water is heaped upon the flat surface upon which the jet is impinging, thereby forming a curved surface over which the following water is deflected. With a stationary vane on which the stream is continuously playing, the loss of force due to this cause is very slight. When, however, the impact is taking place intermittently on a moving vane, the dead water is discharged after very inefficient action at the end of every short period of action, and the total loss in effective work may be considerable. This loss is reduced by placing a solid projection in the bucket, which takes the place of that formed by the water and leaves all the water free to be deflected in the most efficient manner. As regards the second function of the wedge, it is well known that when a stream of water strikes normally upon a surface, it is deflected equally in all directions. This is illustrated in the wheel bucket. The same action takes place when the stream strikes centrally upon the apex of a cone. This is undesirable in the case of the vane of a water wheel, as the water which is deflected towards the centre of the wheel gets into position to strike the back of the following vane, thus opposing the useful effect of the action. Then the jet strikes a wedge, it is cut into two portions, which are deflected away from one another in a plane perpendicular to the cutting edge of the wedge. In a wheel this motion causes the water to be discharged at each side of the wheel where it is free from all liability to interfere with any following parts of the wheel.

Numerous modifications of the form of the curved surfaces of the buckets have been brought out at different times by inventors with a view of modifying the passage of the water over the vane in some particular, but it is not necessary to describe them more particularly.

Of the impulse wheels in use at the present day the best known is probably the Pelton water wheel. These wheels are made in sizes varying from 6 in. to 6 ft. in diameter, according to the head of water available, and the velocity required. These wheels have been applied under heads ranging up to 1,700 feet, and, as has been said, there is no doubt that under such conditions the highest efficiency is realized. On the other hand, there are said to be instances in which Pelton wheels are running with good results under heads of from 50 to 75 feet.

The writer recently made a series of tests on a small wheel of this class, catalogued as the Pelton Motor No. 3. This wheel is approximately 18 in. in diameter, and the weight of the whole machine is given as 320 pounds.

The tests were made in the hydraulic laboratory of McGill University, and a brief description of the methods employed will be given. It was impossible to make tests with heads as high as some of those under which these motors run. The maximum head employed was that afforded by the city supply from the high-level reservoir, which gives a pressure of 125 lbs. per square in. in the laboratory, equivalent to a head of 290 feet. Lower pressures were also obtained by throttling the supply from the same source. These trials will give an idea of what may be expected of this type of motor when used under ordinary heads of from 100 to 300 feet. In many districts these are as large heads as are commonly met with. Also, where it is proposed to take power from a water-works system, the pressure under which water is supplied would rarely exceed 125 lbs. per square inch. In the present series of trials the wheel tested was small compared with many in use: the effective work done did not in any case exceed 7 horse-power. There is no doubt that with a machine designed on a larger scale, as with larger heads, the efficiency would show some increase over the values found in the present case. The results obtained in these experiments are offered as bearing directly on the question of the utilization of this system for small amounts of power under the conditions usually met with in districts outside those referred to as abounding in very high falls of water. With reason and judgment, the general conclusions arrived at by the consideration of these results may be extended to cases where the machinery and the generation of power is on a larger scale.

For the purposes of trial the wheel was set up as received from the makers, and the auxiliary apparatus was fitted in accordance with their instructions. The water, after passing through the valve which was used to regulate the pressure, was led along a length of 2½-inch pipe straight for 8 or 10 feet before reaching the nozzle. A Bourdon gauge was fitted on the supply-pipe less than one foot from the mouth of the nozzle-tip. This gauge was arranged on a pressure-chamber, enveloping the pipe and communicating with the interior through a series of small holes. Before being used the gauge was calibrated by means of a gauge tester. In the experiments the pressure in the pipe of course varied slightly. The pressure was read at intervals of one or two minutes, and the mean value during the whole trial was accepted as the pressure under which the flow took place. The extreme variation of the pressure was about one pound per square inch.

Three different sized nozzle tips were supplied with the wheel. These nozzles tapered gradually on the inside from the diameter of the supply pipe to that of the actual orifice. The outlet diameters were: .5277 in., .6307 in., .7532 in. Sets of trials were made, using the largest and smallest of these nozzle tips, the largest giving the more satisfactory results. The water was discharged from the motor into a flume beneath, whence it ran into measuring tanks, and all the water used was thus actually measured. For the purposes of these trials two tanks were used, each of the capacity of 1,000 gallons; these had both been previously calibrated. The power given by the wheel was estimated by means of an absorption brake and a revolution counter. The shaft was provided with an 18-in. diameter brake wheel of special design, and the power was taken off this. In the earlier trials the brake consisted of one or more cords embracing a suitable arc of the periphery of the brake wheel, and having spring balances attached to the tight and slack ends to indicate the corresponding tensions in the cord. As the power varied slightly all the time, both readings were taken at intervals of one or two minutes, and the means used in calculating the final result of the trial. Later a direct-reading, self-adjusting brake, designed by Mr. Withycombe, was substituted for the cords and spring balances with very satisfactory results.

An ordinary revolution counter was used, but arranged to be thrown in and out of engagement with the shaft at the beginning and end of each trial. The necessary readings could thus be made at leisure, ensuring greater accuracy.

In addition to the revolution counter a tachometer was connected to the shaft. This served as a guide when adjusting the load on the brake wheel previous to a trial to give a desired speed of running. It also served to indicate any considerable departure from the intended speed which might take place during a trial, and which would vitiate the accuracy of the calculated results.

Before passing to the examination of the experimental results of the trials, it may be well to make a brief theoretical analysis of the subject. The elementary theory of an impulse wheel is very simple—so simple, indeed, that no attempt seems to have been made to consider to what extent known and observable phenomena may modify theoretical calculations; but rather the elementary theoretical result is generally taken as the last word which can be said on the subject from a theoretical point of view.

In the following investigation the efficiency is deduced from a consideration of the circumstances, as far as they can be mathematically expressed, under which the mechanical action takes place.

In the elementary theory of the impulse water wheel the assumptions generally made are substantially as follows:

1. That the jet has the theoretical velocity due to the available head of water. 2. That the jet strikes the vane centrally and tangentially to the wheel. 3. That the jet passes over the surface of the vane without any loss of relative velocity. 4. That the vane is so formed as to turn the stream through an angle of 180 deg. completely back on itself.

(To be Continued.)

FIRES AND FIRE-PROOF CONSTRUCTION.

Editor Canadian Engineer:

Sir,—I have, as requested, looked through the pamphlet you were kind enough to send me, on the Paris Charity Bazar Fire, by Arch. E. O. Sachs, author of Fires and Public Entertainments, Modern Opera Houses and Theatres, etc.

This paper was prepared by the author for the Architectural Association, and read at its second ordinary meeting, session of 1897-98, Hampden W. Pratt, F.R.I.B.A., president, in the chair, and was commented on after its reading by Richard Roberts, L.C.C., vice-chairman Theatres Committee, London County Council; Sid. Gamble, A.M.-Inst. C.E., F.S.I., second officer Metropolitan Fire Brigade; Major Fox, chief officer Salvage Corps; Thomas Blashill, F.R.I.B.A., F.S.I., superintending architect London Common Council; Capt. Dyson, chief officer Windsor Fire Brigade; William Archer; Henry Lovegrove, A.R.I.B.A., F.S.I., district surveyor for Shoreditch; Max Clarke, A.R.I.B.A. It has been published by the British Fire Prevention Committee, C. and E. Layton, publishers, Farringdon street, London.

I find the consensus of opinion in this case to be that while the fire was caused by an explosion of some of the essential oils used in the exhibition of the Kinemetographic views, the conflagration and the destruction of the building were disastrously hastened by the fact of the roof drapery having been immediately ignited by the explosion, the flames in an instant running along the whole building, some 300 feet in length by about 40 in breadth, setting fire to the woodwork and flimsy paper and other decorations of the interior, which, falling from above directly onto the heads of the lightly-clad ladies in attendance, set fire to their hair, their head gear and dresses, thus causing the simultaneous and almost instantaneous death of 124 persons on whose heads and shoulders at the same time the broken glass from the continuous skylight was falling, cutting into their flesh and inflicting painful wounds and bruises. Still, quick as the destructive element was in bringing about this most terrible result, the committee is of opinion that had the several emergency doors which were barred and bolted at the time, been opened as they should have been by persons told off in advance to do the duty, not one half of the fatalities would have occurred, maybe not one tenth of them, as the victims issuing into the open could have been cared for by outsiders, who would have seen to the safety of all of them and have probably reduced the casualties in most cases to more or less severe injuries to be got over in course of time.

Mr. Sachs recalled the Vienna Ring Theatre fire of 1881, with its 450 fatalities; the Opera Comique fire in 1887, with a death roll of 115, and other great catastrophes; the Exeter theatre fire of 1887, where 160 lives were lost, followed by a serious fire at Oporto with the loss of another 100 lives. He might also have remembered the Bordeaux theatre fire, the Santiago church horror, where 2,000 souls were hurled into eternity, and the Brooklyn theatre fire of 1872 (I believe), where 276 more lives were sacrificed. Mr. Sachs comments upon the fact of how soon these disasters fade from memory, most of them, he says, having been forgotten within from three to seven days of their occurrence.

The London Committee calls on Parliament, or intends doing so, to interfere and force municipalities to attend to the safety of the public by refusing to sanction the erection of such flimsy and dangerous structures and decorations, and I am certainly at one with the committee in refusing to understand how it is to be considered as interfering with the individual liberty and action to enact such laws, any more than legislating on compulsory vaccination and other hygienic safeguards to the public health; for, as above set forth, there is no doubt that, had not the incriminating ceiling cloths been there, or one of asbestos or other inflammable material, and parties at hand to open the seven doors of the building aggregating some 40 feet in width, the Charity Bazar horror would not have been to any extent as serious as it has proved to be.

(Continued on Page xv.)

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For the Canadian Engineer.

MUNICIPAL OWNERSHIP.

BY RODERICK J. PARKE.

The discussion of this interesting and important question has during the past few years called forth arguments so varied and so numerous that to the non-technical, although directly interested, citizen, the matter has assumed of late a more or less chaotic condition, and a satisfactory solution seems to be no nearer achievement than formerly. For the benefit of those who have been unable to follow the arguments through the columns of the various technical journals, the writer will endeavor to present as briefly and clearly as he can the principal considerations influencing the agitations for and against, and the actual control of, municipal industrial services, and more particularly that branch of the services which embraces the supplying of electrical current for street lighting and private consumers' purposes. This article is not intended to advocate municipal in preference to private ownership, or vice versa, but merely to place before the reader those facts which will have to be carefully considered before an intelligent, unprejudiced conclusion can be arrived at respecting either form of ownership, to the possible exclusion of the other, in those localities in which the question may arise.

To present the subject in a proper light, it is necessary to first ask and answer this question, namely, "What are the principal motives prompting the increasing agitations in favor of municipal ownership? The answer is found to be: (1) The prospect of reducing the cost to taxpayers and private consumers for street and private lighting services. Other motives in the order of their importances are: (2) That the municipality should avail itself of the profits of commercial services, for obvious reasons; (3) Dissatisfaction with the service as rendered by the local company; (4) Local political considerations, and less frequently, purely personal motives among some certain citizens.

Granting, then, that the first-mentioned motive is the prime one influencing the agitation, the question resolves itself not as to who should own the source of supply, but as to whether a cheaper and more efficient public and private service cannot be obtained, and if so, at what proportionate reduction on present cost. Present results show beyond the possibility of a doubt that, giving the same conditions as formerly, in reference to population, cost of fuel and other local conditions, electrical current can be profitably supplied at in some cases a very considerable reduction to the consumer, if modern methods and apparatus be adopted by the central station manager. Competent authorities emphatically point to the fact that if it can be shown that private enterprise can supply municipal industrial services as cheaply and economically as through municipal ownership, very few will be disposed to question the policy of permitting private ownership to continue, providing, of course, that the private corporation will accede to the popular demand. Unfortunately, however, the local company, secure in the monopoly it holds, more often exhibits an utter disregard for the rights of the public, hence the movement for supplying a remedy through municipal ownership. Other reasons for this disregard are lack of enterprise and ability on the part of those responsible for the inefficient and unprofitable condition of the system. In villages and the smaller towns, however, where the demand is necessarily confined within certain limits, the cost of manufacturing is proportionately higher, even with the most efficient machinery, than is the case in the larger towns and cities, hence the public should exercise careful discretion when attempting to compare prices existing in any two localities having a marked difference in population. The individual commercial conditions should also be carefully compared.

The public has every right to demand in return for the privileges accorded to the private corporation in the locality, that the service shall be rendered in the best manner known to be commercially practicable, and at the lowest reasonably profitable prices. Failing in this, the owners of the system can have no cause for complaint in the event of the municipality taking the matter into its own hands, as already illustrated in a number of cases. The question now comes up, whether the company is giving a sufficiently good service to the municipality and at the lowest consistent prices. On this question a great many differences of opinion are found to exist among those directly interested, the only apparent method of arriving at an exact estimate being to have the methods and operations of the system carefully investigated by a board of competent and thoroughly disinterested electrical experts appointed one from each side, and a third chosen mutually by the first two. In this way, assuming the rigid integrity of the experts, the municipality and the company cannot fail in having their respective interests protected fully and impartially, and a mutually profitable and agreeable understanding promoted. If the results of the investigation show that improvement is warranted and feasible, then let such improvement be made. There should be no reason why central stations should be behind the times, or be commercial failures any more than other industrial enterprises, and if through any avoidable mistakes or errors the owners persist in forcing an unsatisfactory and needlessly expensive service on the community, it is plainly the duty of the citizens of that community to endeavor to set matters on a better basis. And conversely, if the company honestly will make every effort to do its work well and in good faith, it certainly has every right to expect and demand good faith from the municipality.

In the majority of instances of disagreements existing between municipal authorities and the central station owners, the trouble is due in a great measure to misconceptions and exaggerated ideas arising through technical ignorance on the part of the former, and often a mutual distrust of the other's intentions and motives, on the part of both, with consequently disastrous results to the vested interests of the owners when the power of a majority is taken advantage of by the municipality. To instruct the authorities sufficiently to enable them to conduct an impartial and competent inquiry into the workings and methods in vogue in the local central station is out of the question, while to expect them to blindly accept the arguments and statements of the owners is in the majority of instances equally inadmissible. The establishment of a provincial board of industrial commissioners, capable of technically inquiring into and competently advising municipalities on such matters, would seem to be the most advantageous method for all concerned, or, in the event of there being insufficient necessity for the permanent existence of such a board, a temporary one could be drawn from among the ranks of those disinterested members of the electrical profession making a specialty of works of this nature. The central station owners where they have not legally forfeited the right to expect leniency and consideration at the hands of the municipality should certainly have due regard shown their interests as far as can be consistently done, in view of the fact that at the time when the station was established, assuming this to have taken place not less than five years ago, comparatively much inferior and more inefficient methods and apparatus were taken advantage of as being the best then known. In those instances where during the profitable operation of the central station for a period of several years, the owners have shown culpab'e lack of enterprise in failing to improve the particular system where such would be necessary in order to assure the supplying of an increasingly efficient and up-to-date service at proportionately lower prices, the justice of compelling the municipality to repay to the owners their original outlay for the equipment, is open to serious question, particularly if that equipment be out of date, insufficient, and in a badly depreciated condition. And even though the owners be willing to accept a considerably reduced price for their equipment, the fact must be borne in mind that in order to place such on a modern and more efficient basis the only alternative left is that accepted by the wide-awake manager, namely, to discard the old and install more capacious and efficient machinery and to practically reconstruct the system. Where any part or portion of the old equipment can be advantageously continued in use as a part of the new system, a reasonable allowance should be made on such to the owners, and that part or portion adopted. The tendency, however, seems to be in the majority of cases to ignore the owners as far as possible, and to purchase an entirely new outfit. Whether this policy be a judicious one depends altogether on the nature and quality of the local system to be supplanted, and will be discussed in a future article. It may be remarked just here, however, that a great deal of the machinery and apparatus installed a few years ago would be dear at any price if adopted in a modern central station, where the latest types and highest quality of equipment are necessary to meet the conditions under which the station should be operated. The enterprising manager, alive to his own interests, has already perceived the necessity of operating his equipment under the most economical methods, and that in order to do this the many needless and avoidable wastes of power in process of translating the energy of the coal pile into light and motive power due to poorly designed and inefficient devices must be stopped, as far as the latest developments of the science have shown to be practicable. In consequence of this the said devices have been disposed of to the dealer in second-hand apparatus, or sent to the scrap heap, and the more efficient apparatus installed. If, then, the practical manager finds it to his interests to get rid of his out-of-date machinery, is there any valid excuse for compelling the municipality to cover the losses incurred through the incompetent manager's failure, when it is found necessary or advisable to establish an improved system on its own account, and where in any event the old system would have to be replaced by a new one ?

An article of much interest, bearing on up-to-date management of public lighting plants, appears in the editorial columns of the Electrical Engineer of May 26th, 1898, and is well worth reproduction, in view of the fact that this journal actively opposes municipal ownership. This article, entitled "An Object Lesson for Municipal Plant Advocates," says :—

"It is now about ten years ago that the then Mayor Grant of New York ordered the electric light poles of this city to be hacked down with axes and the wire carted to the city junk yard. This policy of violence was the first step toward the placing of the wires underground, and although no one would now go back to overhead wires, the method adopted for bringing about the result will always be considered arbitrary and uncalled for. In striking contrast with the ex-mayor's procedure is the painstaking and intelligent manner in which the officials of Providence, R.I., have gone about adjusting questions of this kind with the local lighting contractors, the Narraganset Electric Lighting Company. The latter company has an exclusive franchise for electric lighting in the city, but instead of abusing its privilege, has steadily increased its hold on the public confidence by its policy of fair dealing emphasized by a steady reduction in rates. Recently a committee of the city council was appointed to report upon the placing of high tension wires underground, and the committee's report now lies before us. Before formulating its report the committee undertook a trip of inspection of underground work in various cities, and that it was not a junket is evident from the fact that the committee traveled at its own expense. The proposition which it sanctions for adoption by the city council is substantially that submitted by the electric lighting company. This contract provides for the gradual removal within three years of all the overhead wires and their placing in underground conduits within what is termed the first building district of the city. At the same time the lighting company agrees to a gradual reduction of the price for lighting from 35 cents to 30 cents, to take effect in 1903, for 2,000 c.p. arc lights burning 4,000 hours per year. Considering the expense which the burying of the wires will entail, the rate just quoted will be conceded to be very low—one indeed that will require the highest economy in all departments of station work. But President Perry of the Narraganset Co. has always had a reputation for wanting the best that money can procure, and we doubt not that under his management the company will, as heretofore, remain among the most substantial electric lighting properties in the country. At the same time we must express our gratification in these days of municipal ownership agitation that the city council of Providence has among its members men who are sufficiently intelligent and patriotic to weigh and determine the questions submitted to them in a spirit of fairness to the interests both of their constituents and of their lighting contractors. We feel certain that if every city in the Union had adopted the arrangement entered into by the city of Providence and the Narraganset Electric Lighting Co., by which the latter is limited to a profit of eight per cent. on its share capital in lieu of the grant to it of an exclusive franchise, very little would now be heard of municipal ownership of electric lighting plants in this country."

If, as shown in the above instance, the manager of a large and influential electric lighting company has found it much more to the interests of all concerned to endeavor to please the public as far as he can, instead of abusing the privileges accorded him, is it not apparent that for those cases where disputes are now in progress between the municipality and the local lighting company every possible effort should be made towards effecting an amicable settlement, before arbitrary measures are resorted to by the former? Not only in this one instance, but in numerous others as well, have the beneficial results of intelligent, impartial and amicable investigation been clearly and conclusively demonstrated, and there can be no doubt that if the company will show due consideration for the rights of the public at every available opportunity, the latter will not be slow to accord privileges and favors, which under less agreeable circumstance would be denied, perhaps with much indignation.

Where negotiations are to be made between the municipality and the company, the latter has every right to demand that those appointed to advocate the interests of the former, shall be men whom, as far as possible, are capable of conducting an intelligent and competent inquiry, without prejudice to the rights involved, and as the public demand full justice, sometimes with unnecessary vehemence, let them consistently endeavor to provide that justice, in the strictest sense of the term, shall be obtained, not only for the one side, but for both.

(To be continued.)

—Now that Anglo-Saxon unity is becoming a favorite catch word with such as are in high places watching to see which way the wind blows, the people of Toronto are beginning to realize the benefits they have unwittingly conferred upon the Empire and the race by allowing Architect Lennox his own sweet way in building the city hall. Such a combination as it is of Canadian hard-earned gold and United States ready-made fixtures and materials will be a monument to our desire to freely give and take as our neighbor sees fit. Having provided such a monument, we hope that the corpse of the desire will be carefully interred under it, and that in future when Canadian manufacturers tender at less prices than their neighbors for articles of the same class, their tenders may not be rejected merely because the tenderers are not aliens and their wares are not made in the United States.

A POLE RAILWAY.

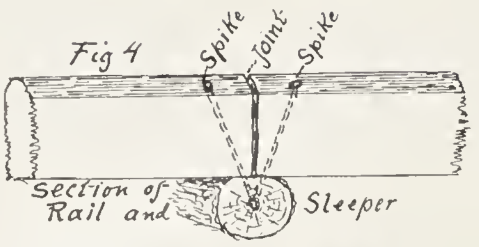
From Weymouth, N.S., to Nouvelle France, a distance of sixteen miles, there is a railway whose construction and equipment are of great interest to the lumber trade, and in fact to all who are engaged in opening up new or sparsely settled districts. This pole railway was built by Emile Stehelin, of Nouvelle France, N.S., who has kindly given The Canadian Engineer some details of this novel work. The line serves six stations in its course: Nouvelle France; Doyle Lake, where there is one sawmill; Riverdale, where there are two sawmills; Woodville, where there are three sawmills; Corberrie, a thriving little village, and Weymouth on the coast.

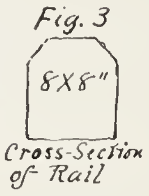
A Pole Railway in Operation.

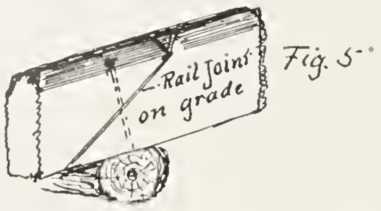
On level ground the construction of a pole railway is a very easy matter, but in this part of Nova Scotia the country is hilly and there are a great many swampy stretches which made construction more expensive than would often be the case. The cost of the whole line, including equipment in this case, was about $3,000 per mile. This included grades of three to six per cent., a number of bridges and several embankments of from ten to fifteen feet high. On level ground the construction consists in laying down sleepers ten feet long and three to four feet apart, on which is laid a spruce rail, sawn as shown in Fig. 3. The rails are twenty to thirty-five feet long, and are trimmed square for flat stretches and bevelled for grades as shown in Figs. 4 and 5. The joints are made and the rails secured by twelve-inch wharf spikes as shown.

A Pole Railway—Construction.

The method followed in building bridges and embankments is to lay a series of timber floors one upon another, each at right angles from the last, till the required height of the pier of embankment is obtained. With careful work and exact cutting of the timber, there is practically no limit to the height to which such piers and abutments can be carried.





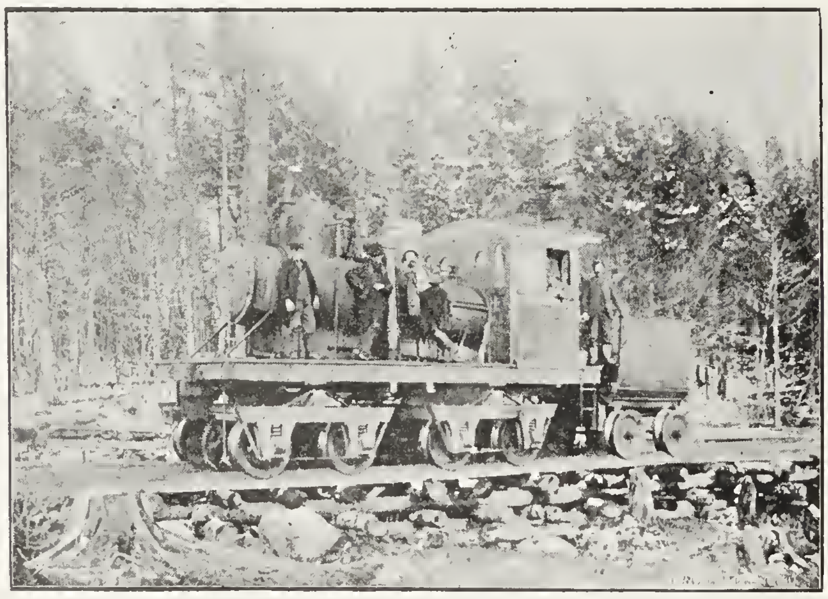


The locomotive "Firefly," shown below, is the one first used by the road. This is an old stationary boiler and a twenty horse-power engine, mounted on a truck. The wheels are driven by an intermediate crank wheel. Considerable difficulty was experienced in adjusting the parts of this engine, but it was finally got to run very satisfactorily, and is used for hauling logs to the sawmills.

A Pole Railway—The Locomotive "Firefly."

The "Maria Theresa," shown below, is an entirely new locomotive, built expressly for the line by a Nova Scotia firm. It has four cylinders of twenty horse-power each, driving two trucks of four wheels each.

In operating a line of this kind, one of the greatest difficulties to be contended with is the amount of friction developed by the wheels, which do not run on the wooden rails with at all the same ease as on steel or iron. The locomotive should, therefore, be made as light as is consistent with the power to be developed, the friction of the wheels being sufficient to compensate for the lack of weight in the locomotive. It is to obviate as much of this friction as possible that the upper surface of the rail is cut in three faces. At present, only six miles per hour is obtained regularly, but Mr. Stehelin hopes with some modification of the locomotive wheels to obtain higher speeds. The engines are wood burning, but it is proposed to substitute coal, which can be had very cheaply at Weymouth. The freight cars used on the pole railway are twenty feet long on two trucks with four wheels each; the passenger car is twenty feet long, and is covered and closed; there is also one small passenger car to carry four persons.



A Pole Railway—The Locomotive "Maria Theresa."

CHROMIC IRON IN CANADA.*

For a long time chromic iron was regarded only as a mineralogical curiosity, and its industrial use only became known when it was applied to chemical industries. The application of the salts of chrome to dyeing dates from 1820, and the industry of the manufacture of bichromate of potash was inaugurated about that time. It was only in 1883 that potash was partially replaced by soda. Down to 1827, the very limited consumption of this product was supplied from the region of the Ural Mountains. In 1827, chromic iron was discovered by Isaac Tyson, jr., in the neighborhood of Baltimore, and subsequent search resulted in further discoveries of it in other parts of Maryland and Pennsylvania. From that time to 1862 the Baltimore region supplied the market in the United States and Europe, the most important centre of consumption in the latter being Glasgow. In 1845, Mr. Tyson, in order to utilize his surplus output, established the manufacture of bichromate of potash, which is still in operation in Baltimore under his direction. In 1848, the deposits in Asia Minor were discovered, which, ten years later, became, so to say, the most important factor in the production of chrome in the whole world. In 1869, discoveries of the ore were made in California, which have supplied the American industry from 1878 down to these latter years, and next in New South Wales and New Caledonia, and lastly in Canada and Newfoundland in 1894.

Chromic iron, or chromite, has a density of 4, 5, say about 7 cubic feet per ton, its hardness is between 5 and 6, it gives a brown stripe and dust; it is unattackable by acids and infusible at the highest temperatures. Some authors say that it is sometimes magnetic, but J. Obalski, M.E., in describing the deposits in Quebec, did not observe that it was so in that region. It is true that some samples of magnetic iron in the serpentine contain chrome, but, at least for the Quebec district, its non-magnetic condition is a distinguishing characteristic of ores that can be worked for chrome; its appearance moreover is that of magnetic iron or titanic iron. It is composed of iron in the state of protoxide and sesquioxide of chromium; nevertheless the elements, iron and chrome may be, in part, replaced by magnesia and alumina, which then reduce its grade, without prejudice to the mixture with the serpentine, which is moreover easy to discern. Theoretically it may be said that the yield in sesquioxide is 68 per cent., but it is rare for the real grade to exceed 56 or 57 in picked specimens, and the industrial tests on shipments very seldom reach 53 or 54. The merchantable grade for the manufacture of bichromate of potash is 50, but some buyers accept 49 and even 48. Under that, the ore is classed as of inferior quality. The Black Lake ores have given 49.8 and 50.3 on shipments (analyses of the Baltimore chrome works), and 54 and 56 on specimens (Donald analyses) 58.06 (Pittsburg testing laboratory), concentrated specimens from Black Lake 56.28 and 60.66 per cent. (Ledoux &

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*The facts here presented are taken from a recent report by J. Obalski, M E Provincial Inspector of Mines for Quebec.

Co.). Milton L. Hersey has also made numerous analyses of these ores, which frequently gave high grade. Shipments from Breeches Lake have reached 55 per cent. In chemical industry, the ores which are poor in silica are preferred, and for certain uses buyers fix a limit of 12½ per cent. of metallic iron and 8 per cent. of silica.

The existence of chromic iron in the serpentines of the Eastern Townships, of Quebec, has long been known, but until 1894 hardly any effort was made to develop the deposits. According to the geology of Canada for 1863, the first attempt in that direction was made in 1861, when about ten tons were extracted in the neighborhood of Lake Nicolet. Some twelve years ago, a small quantity was also taken out in lot III, 24 of Wolfestown, and in 1887 Dr. J. Reed shipped to Philadelphia 54 tons derived from lot X, 1 of Leeds. Lot IV, 16 of Thetford, also yielded four or five tons, but of low grade. About the same time, specimens sent to Antwerp Exhibition had attracted attention, and orders for ore had been received, but the known deposits did not appear to be rich enough to be worked with profit. In April, 1894, an unknown mineral having been discovered near Black Lake by a man named Provençal, a specimen of it was brought to the office of the Provincial Mining Engineer, who at once recognized it as chromic iron of a high grade, and advised that the mine should be worked, indicating at the same time where a market could be found for the product. The Nadeau-Provençal mine was thereupon opened; and the selling price of the ore being deemed remunerative, prospectors entered the field and other discoveries were made in the neighborhood, especially in the township of Colraine, thus giving rise to an industry which promises to become prosperous.

The presence of these deposits is indicated by a sort of black spongy crust, of ferruginous aspect, appearing in spots on the serpentine and by the loose rocks found on the surface. Sometimes the crusts are only superficial, and at others they penetrate into the serpentine with a thickness of several inches, which may increase and attain several feet. In still other cases, the mineral shows itself at once on the surface with its metallic aspect and occasionally in its greatest thickness. But the deposits have a character of irregularity; they seem to be almost independent of each other, and sometimes suddenly disappear without leaving any trace to warrant further work. No defined walls except the planes of ordinary fracture in the serpentine are observable. The question of the depth to which these deposits extend has been mooted, and it has even been suggested that borings should be made to determine whether they cannot be found where they do not outcrop at the surface. Such deposits should exist and chromic iron has been found at a depth of 30 feet in an otherwise unproductive shaft sunk for asbestos by the Beaver Asbestos Co. on lot Colraine C. 30. Geologists have given considerable study to the origin of this mineral, and have established, in the Quebec region at least, that while it occurs in the dark green serpentines of the Eastern Townships, it is absent from the buff or honey-colored serpentines of the Laurentian system.

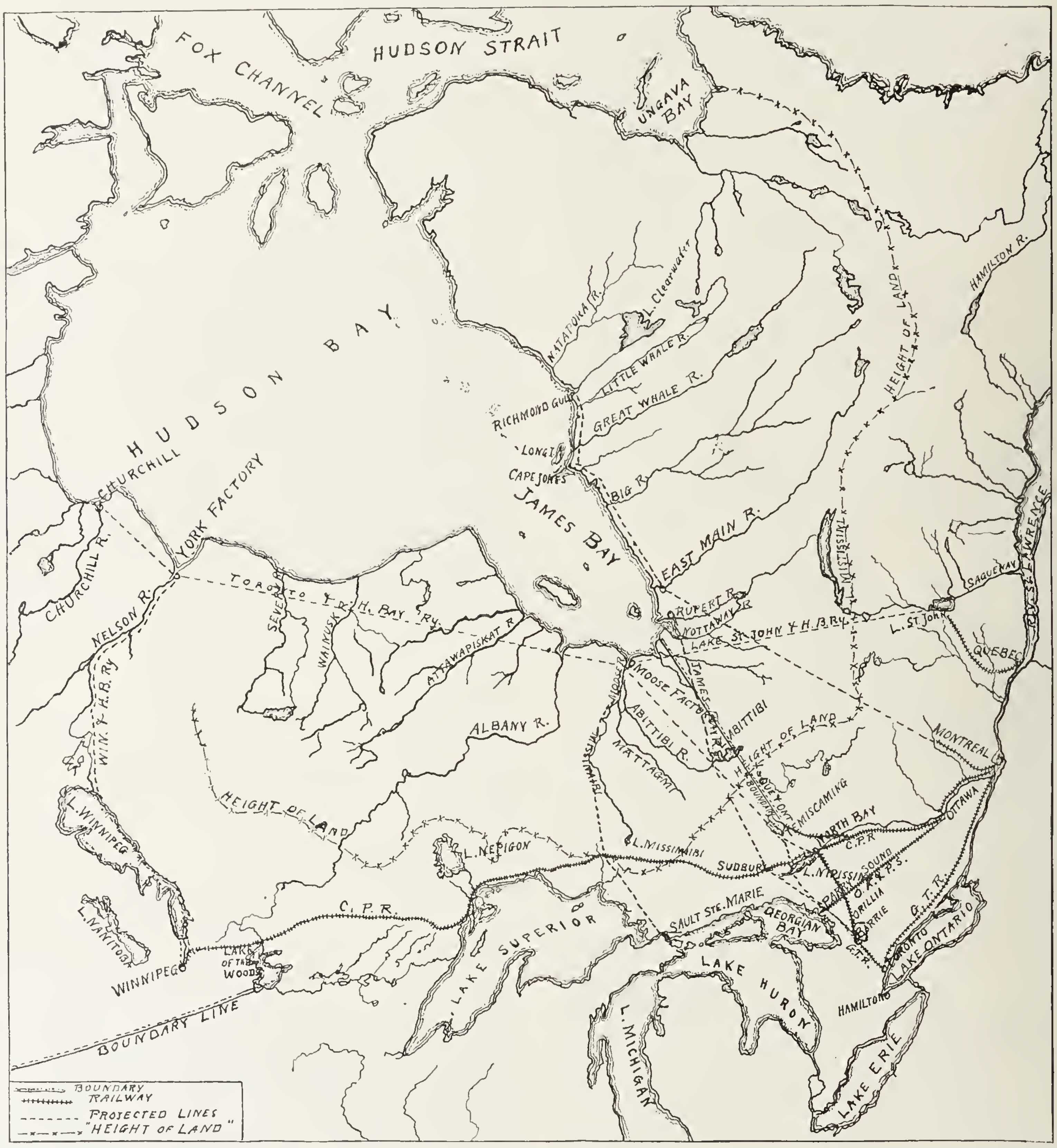
Chromic iron is also further found on the west coast of Newfoundland, at Bluff Head, Port au Port Bay, where a very important bed is being worked by the Halifax Chrome Company, which during the summer of 1896 took out 1,500 tons and shipped about 200 gross tons, of which 145 went to Pittsburg, where it yielded 49.90 per cent. (Transactions of the American Institute of Mining Engineers, Geo. W. Maynard). The author of this paper says that the ore gives from 39 to 50 per cent., and he mentions the discovery of a mass 97 feet long by 45 feet wide.

With these deposits in Canada, there seems no reason why a great chemical industry should not be built up in Canada, along with a considerable addition to our mining development. Chromic iron is used for the manufacture of bichromates of potash and soda, which are employed in the dyeing and printing of calicoes. These products form the bases of the chrome colors, yellow, orange, green, etc.; they are also utilized in the construction of certain batteries of electric piles, in the tanning of leather, in chemistry, and slightly in medicine. Chrome enters into the composition of the ferro-chromes, which are used to make the chrome steels that are noted for their very great hardness, and employed for the armor plating of vessels and forts, and for the making of shells, tools for cutting iron, shoes and dies in stamp mills, safes, etc. Ferro-chromes of different grades, ranging from 40 to 90 per cent. of chrome, are made while the chrome steels contain from 1 to 10 per cent. of chrome. They are also employed in alloys with aluminium. Chrome imparts to the metals with which it is allied great hardness and inalterability, and increases their elasticity, these qualities varying with the grade in chrome. More recently low-grade chromic iron has been employed on account of its essentially refractory qualities, in the construction of certain parts of furnaces exposed to high temperatures, and especially in the construction of the inside parts of open hearth furnaces and of reverberatory furnaces for copper smelting. A certain quantity of it is regularly used for this purpose in the Pittsburg district, where also special chrome fire bricks are manufactured, two companies being engaged in this industry. In this case, the medium grades are preferred, on account of the price. In latter years about 2,000 tons have been used in the United States for these purposes. It is also employed by the European metallurgical establishments.

In the Province of Quebec there is a pretty extensive region in which chromic iron occurs in commercially workable quantities, and when it is considered that these deposits are located at distances ranging from several acres to five and nine miles from the line of the Quebec Central Railway, and on heights which render their working easy, that labor on the spot is cheap and fuel wood close at hand, it would appear that it would be difficult to find a more favored country as regards this industry. It has been prosecuted there since 1894, but by very primitive methods, not a single steam machine having been yet employed; nevertheless over 10,000 tons have been taken out to a value of about $140,000. Nova Scotia coal is worth $4 a ton at the Quebec Central Railway. Furthermore, the chromic iron ores of the region in question are concentratable and capable of furnishing a very large quantity of high grade. The Government still owns many lots, which can be fully bought out at $400 per 100 acres. There have been no deep workings yet, and it is safe to conclude from what has been said that this district is destined to become an important factor in the production of chromic iron for many years to come.

ON TO HUDSON BAY.

Hudson Bay, Canada's great inland sea, is about 600 miles across from east to west, and measures about the same distance from north to south, or if you include James' Bay, its southern arm, it will be 1,300 miles long from its northern to its southern extremity. Its average depth is 600 feet, and its floor is so level and uniform that if it were raised out of the water it would form one vast prairie like that of Manitoba. The waters of James' Bay, however, are so shallow (except through one wide channel leading down its centre to Moose Factory), that a boat oar can touch bottom many miles from shore. This vast inland ocean is a basin into which 3,000,000 square miles of land are drained, and so large is the quantity of fresh water pouring down, that the waters of James Bay are only slightly salty. Hudson and James Bays receive the waters of twenty-five large rivers besides those of numbers of smaller rivers, some of which are unknown and unnamed. Notwithstanding the vast area of Hudson Bay (about 500,000 square miles), no part of it is within the Arctic Circle. The resources of this vast region are only now being faintly realized. We now wonder that the natural fertility of Manitoba and the North-West Territories, and the great mineral resources of British Columbia and the Yukon, remained so long unknown, or, at least, unappreciated by the people of the older Provinces. In a few years when the great valley of James and Hudson Bays shall have been opened up by railways, we will wonder still more that it, too, should have remained so long locked up. The reports of early travelers and explorers, who, in order to make interesting stories, have exaggerated the character of the climate, have no doubt been one of the stumbling blocks in the way of opening up our great northern land. The climate and surroundings of Hudson Straits also have been so confounded with the climatic features of the great inland basin as to discourage inquiry. Hence it is that many intelligent Canadians imagine that the waters of Hudson Bay form one immense ice field during the greater part of the year. As a matter of fact, Hudson Bay itself is never frozen over any more than Lake Huron or Lake Superior. Navigation can be carried on throughout Hudson Bay proper every day in the year. It is only in Hudson Strait that difficulty from ice is encountered. In James Bay, owing to the shallowness and freshness of the water, ice is formed during the winter, but this ice with the river ice breaks up in April and May at about the same date that the St. Lawrence River is free from ice. The trouble in navigating Hudson Strait is not from locally formed ice, but the great polar ice fields that are annually broken up and drift down Davis Strait and Fox Channel, where quantities of it are deflected by the inset of the Atlantic tides and turned into the Strait. The length of time when the Hudson Straits are navigable, varies according to different navigators and explorers all the way from 3½ to 6½ months in the year. Notwithstanding the pessimistic views of many regarding these Northern waters, the fact remains that though Hudson Bay and Strait have been navigated continuously since 1668, when the Hudson Bay Company was formed, the shipping disasters have been remarkably few, so few indeed that for the last half century the Hudson Bay Company has ceased to pay insurance on



its vessels, having found it cheaper to assume its own risk. Dr. Bell, the Dominion Government explorer, agreed with the reports of those who have spent years in residence on the shores of the Hudson Bay, that these waters are remarkably free from violent storms, particularly in summer months. Taking all months of the year together, the Hudson Bay is a mill pond compared with the north Atlantic, while the total hours of fog in the year are only one-third those of that part of the Atlantic through which most of our present ocean steamship tracks are mapped. These are important points which are now beginning to be realized by Canadians.

When we come to the question of climate, we must remember that we are dealing with a stretch of country nearly 2,000 miles from north to south if you take the Height of Land of northern Ontario and Quebec as its southern boundary. There must of course be a considerable variety of climate in so large an area. Taking the country from the Height of Land to the northern part of the James Bay on both the east and west sides, we have the most positive evidence of a climate as temperate and healthful as any part of the St. Lawrence Valley or that part of Ontario between the Ottawa and Georgian Bay. The voyageurs who accompanied some of the Dominion Government explorers to the James Bay were surprised at the mildness of the climate and the high summer temperatures of the water, compared with their experiences along the shores of Lake Superior where most of their life had been spent. This is accounted for partly by the greater length of the summer day in these northern regions and partly by its nearness to the level of the sea. Dr. Bell found the average temperature of sea along the east coast of the Hudson Bay to be 53 degrees Fah. and of the rivers 61 degrees, and he and his party bathed in the sea almost daily on their journeyings along the coast. The various farm and garden products that have been grown for the last half century or more by the Hudson Bay factors and the missionaries around the Bay, and the character of the forests, are further evidences of the suitability of the climate for successful settlement. Starting from the Height of Land in either Ontario or Quebec, the traveler passes through an extensive shallow basin, comprising not only vast tracts of splendid agricultural land, but numberless lakes of all sizes linked together by rivers and streams. From the northern rim of this broad basin the land again slopes gently towards the shore of James and Hudson Bays, cut through here and there by rivers. These numerous rivers, though navigable for stretches 100 miles or more, have numbers of falls and rapids, which, while they are an impediment to navigation, give promise of immense industrial advantages in the creation of water powers. On the Abittibi one exploring party had to make 21 portages, owing to the rapids, falls or chutes, some of which could be transformed into ideal water powers. There is probably no similar area of country in the wide world capable of yielding such an enormous amount of water power for industrial purposes. Right here we may say, that in view of the illimitable area of splendid spruce land and cheap power in this region a railway through the Hudson Bay Territory could be made a profitable investment if the wood-pulp industry alone were in question. The finest spruce in the world is to be had in these northern forests, the extent of which is beyond estimation. White and black spruce and the larch tree thrive well up to a point north of Richmond Gulf, and when this line is carried some distance inland eastward it again curves north to Lat. 59, or to a point north of Cape Dufferin. Balsam, poplar, canoe birch, aspen, mountain ash, balsam fir, bird cherry and Banksian pine, have their northern limits at various points farther south on the shores of the James Bay, but in each case this limit is also extended farther north as you go inland to the east and west of the Bay. The white cedar, mountain maple, white and red pine, white elm, red oak, ironwood, basswood, birch, ash, and other deciduous trees are to be found in areas of varying extent from the head of James Bay down to the settled districts of Ontario and Quebec. J. C. Bailey, who was on the exploration for the Nipissing and James Bay Railway, found splendid specimens of Norway pine, yellow and black birch, and sugar maple, many trees measuring from 20 to 40 inches in diameter, and standing 70 to 80 feet high. As to the soil, almost every traveler and explorer has been surprised at its fertility and the depth of vegetable mould. Dr. Bell, in his report to the Government on the country between Lake Superior and James Bay, says: "After passing the 'swampy grounds,' the traveler cannot fail to be struck by the abundance and fertility of the soil exposed on the banks of the rivers all the way to Moose Factory. I have no doubt that at some future time this country will support a large population." Among the agricultural products that have been grown year after year at various Hudson Bay Company's posts, and by missionaries living among the Indians, may be noted barley, oats, rye, peas, beans, melons, cucumbers, castor oil beans, tobacco, balsams, cauliflowers, cabbages, lettuce, turnips, radishes, beets, carrots, onions, coleworts, cranberries, gooseberries, currants, strawberries, raspberries and cherries. Wheat has also been grown at the Hudson Bay posts. Sarsaparilla of a very superior quality grows wild over a wide area of country. Archbishop Tache gives at least 223 species of birds, and 72 species of fur-bearing animals to be found in this region. The wealth of the Hudson Bay district in fur is too well known to need emphasis here. Agriculture in the Lake Temiscaming and Temagam districts has passed the experimental stage, tracts of land having been brought under cultivation, the farmers finding a market in the supply of men and horses engaged in lumbering operations there. An abundance of hay is grown, the clover of the Temiscaming district being said to to excel that grown in any other part of Canada. Root crops are successfully raised. Of oats, barley and peas the farmers have large harvests ; cultivation of wheat is alone limited by the narrowness of the market. All that is wanted to place agriculture in this district upon a well established basis, and open up the rich territory around Lake Abittibi to the north, is efficient railway communication with the commercial centres of the Dominion.

We now come to the mineral features of the Hudson Bay slope, and here it must be remembered that nine-tenths of the country has remained until now absolutely unknown and untouched by the geologist or prospector. The cursory examination of this one-tenth of the region in question has disclosed the following minerals :—gold, silver, lead, iron (magnetic and hematite), nickel, copper, pyrrhotite, zinc, galena, antimony, arsenic, tellurium, platinum, tin, bismuth, molybdenum, cobalt and manganese, while among the non-metallic minerals may be noted agates, carnelians, epidosite, porphyries, granite, syenite, sandstone, quartzites, flagstones, slates, marbles, ornamental argillites, jaspers, garnets, chalcedony, white quartzites for glass making, asbestos, graphite, actinolite, lithographic stone, gypsum, salt, amethysts, soapstone, ochres and other mineral paint material, kaolin, lignite, mica, peat, axinite, limestones, brick clays, petroleum, and last of all anthracite. When we consider how slight has been the geological examination of this region, the foregoing list is certainly imposing, and of the minerals here enumerated

NEW VICTORIA JUBILEE BRIDGE ON G.T.R., AT MONTREAL—VIEW FROM HARBOR GUARD PIER.

at least one-half are known to exist in paying quantities. In some cases the deposits are of incalculable extent, and all that is wanted is railway communication to develop them. The copper belt, a large part of which is nickeliferous, extends all the way from Lake Huron and Lake Superior to Lake Mistissini. Antimony was found near Echo Lake in a vein eight inches wide of very rich ore. On Moose River the gypsum beds are ten to twenty feet thick, and have been traced for many miles from the river. Carniferous rocks are extensive to the south west of James Bay, and in this formation it is expected oil will be found, as in like formations in the Enniskillen fields of Ontario. Large deposits of clay iron-stone are found on the Mattagami River. The ornamental stones alluded to in the non-metallic list are found in remarkable abundance in many places, while some beautiful varieties of unnamed ornamental stones have been discovered. Samples of the granites have been polished and are said by experts to be finer than Aberdeen granite. Of the samples of marbles, some are banded, some clouded and all are easy to quarry. Some of the yellow ochres and Venetian red paints have been found in such a condition that they can be used without grinding. A bed of kaolin is found on the Missinaibi, below Coal Brook. It is overlaid by a bed of beautiful bright sand, of which E. B. Borron says, " I believe that both the kaolin and sand, the one suitable for the manufacture of porcelain and the other for window glass, are there in large quantities." Lignite is found on the Mattagami, the Missinaibi, and the Abittibi, and the beds of peat are declared to be "absolutely inexhaustible." Of other beds of lignite, Dr. Bell mentions some that are 1½ to 6 feet thick. The sample of anthracite found on Long Island, and shown to Dr. Bell, has a conchoidal fracture and a bright lustre, and on analysis yielded 94.91 per cent. of fixed carbon, and only 0.35 per cent. of ash. Dr. Bell was prevented from visiting the locality, but this discovery is of the highest importance to both Ontario and Quebec. On the Abittibi River, the bituminous limestones and carbonaceous shales closely resemble the petroleum-bearing strata of the MacKenzie Basin. Mr. Low, who explored the south side of Hudson Straits last year, says "the schistose rocks of that region are frequently penetrated by numerous quartz veins, and their proximity to masses of igneous rock are conditions favorable to the occurrence of gold. Along with this schistose are large beds of impure iron ore, corresponding with the enormous deposits of bedded iron already found in the Cambrian rocks of the Koksoak and Hamilton Rivers." The clay deposits of Lake Abittibi are unusually rich in aluminum, and this industry alone should justify the exploitation of that region. A sample of the manganiferous spathic ironstone, which is found in such great abundance, was shown on analysis to contain 25.44 of metallic iron and over 24 per cent. of carbonate of manganese. A band of chalcedony seven feet thick was found by Dr. Bell on one of the islands north of Richmond Gulf. "The spathic ironstone bands of the whole Nastapoka chain are found by Dr. Harrington to constitute valuable iron ore. These form a band averaging 20 feet thick throughout the whole group of islands, which have a length of about 90 miles exclusive of the islands to the north." The enormous abundance of the ore is its great feature, and we are told that not only is the ore already broken by nature in inexhaustible quantities, but much of it can be loaded direct into vessels from the steep, rocky sides of the islands. Magnetic ironstone is washed out of the drift in considerable quantities at various places along the coast. The rare mineral axinite, which has been discovered near the mouth of the Little Whale River for the first time in Canada, is found in crystals along with quartz, calcspar, epidote, chlorite and asbestos, also in the granular form. It is of purple color and takes a high polish.

This mere outline of the minerals found in the James and Hudson Basins will show that Canada has more than one Klondyke ; and when it is considered that only a few years ago the large areas of gold and nickel of northern Ontario were unsuspected by the geologists who had traversed the region, it is but reasonable to expect that new minerals will be found and more expensive deposits of those already known will be unearthed in the region under consideration.

The accompanying sketch map is intended to show approximately the routes of various railway lines projected towards Hudson Bay from Ontario and Quebec. The conformation of the country, the abundance of timber, and numerous water channels, render railway construction in this country a most easy problem. The surveys already made show that the highest grades going north from the Height of Land are not more than 1½ to 1.33, and going south not more than 1 per cent. The total elevation above the sea of this Height of Land averages from 850 to 1,200 feet. Though the road projected from Missinaibi is the shortest, it is perhaps not the one best calculated to bring the resources of these northern latitudes to the marts of Ontario and Quebec. The lines extending from North Bay in the one case, and those projected from Lake St. John or Labelle on the other, are the ones most likely to be looked on with favor by the people of Ontario and Quebec to start upon. The commission, of which W. T. Jennings, C.E., is secretary, appointed by the Toronto city council, has done solid public service by bringing this question forward recently ; while the James Bay Railway Company, backed by Senator Geo. A. Cox, Wm. Mackenzie and Geo. H. Bertram, M P., has obtained a bonus from the Ontario Government, and it is said the Dominion Government has also promised to assist in the undertaking. The citizens of Toronto, along with other Ontario cities, are now awakening to the possibilities of this new land, and one may hope they will no longer deserve the caustic comment of Mr. Paterson, who, in discussing the subject, said : " Many rich Toronto merchants would rather sit down on a few corner lots in the city and wait until they rise in value, and aldermen would rather squabble over putting on or taking off half a mill of taxation, than stir outside and bring in trade." The city of Quebec is taking a lively interest in the subject, largely owing to the persistent advocacy of its city engineer, Charles Baillairge, C.E. It is hoped that both provinces will be emulous in pushing forward enterprises that are so certain to increase their population and develop their trade.

VICTORIA JUBILEE BRIDGE, G.T.R., MONTREAL, IN COURSE OF RECONSTRUCTION—LOOKING DOWN THE ST. LAWRENCE.

For The Canadian Engineer.

REPORT ON THE PRECIPITATION SYSTEM OF SEWAGE DISPOSAL IN OPERATION AT HAMILTON, ONT.

BY W. M. WATSON.

During the month of March I visited and made a superficial examination of each of the two sewage works that are intended to clarify the sewage of about 35,000 out of the present population of 50,000 in the city of Hamilton, Ont., leaving the sewage untreated at the outfalls into the bay, at the foot of James street, Stuart street and Queen street, together with the large brick sewer that drains the whole of the mountain slope property and empties into Cootes Paradise. The small works at the east end of the town, on Wentworth street, was built early last year, and it is stated in the engineer's annual report for 1897, that they commenced operations on May 17th. Our readers will find a full description and illustrations of this plant in The Canadian Engineer for January, 1897.

It is stated on page 58 of the annual report for last year, that from the date that the Wentworth street works commenced operation to the end of the year, they treated 114,114,000 gallons, or a daily average of 474,000 gallons. When describing the visit of the Toronto aldermen, to inspect the works, it is stated in the Toronto Evening News that the daily run of the sewage works is only ten hours out of the twenty-four each day, which means that only one set of employees is engaged and that for 14 hours each day the sewage passes over the underground overflow weir to the Burlington Bay, raw and untreated. On page 62 of the report it shows that the actual cost of operating the East end works for 220 days from May 17th to end of year was $4,470.87. Law cost, $704.28. The cost of construction and machinery is given at $38,000. The average cost per day for operating with one set of men 10 hours daily will be $20.32, and $7,415.84 for the whole year. Then add four per cent. interest on $38,000, the cost of plant, viz., $1,520, and allow ten per cent. on the wear and depreciation of value of machinery and works, $3,800, brings the annual cost of only clarifying the sewage at that small works for 10 hours each day from a population of about 12,000, and which appears to be void of trade or strong sewage, to $12,736.80, or over $1 per head. Should the works be run night and day, the management expenses would be double, and still the clarified sewage will go into the fresh water, unpurified, and containing most of the injurious and poisonous matter that is discharged from the skin and intestines of living creatures, jeopardizing the health of the inhabitants residing near the waters into which the clarified sewage is discharged, and afterwards setting up putrefaction, assisted by the lime that is used as a precipitant. If the amount treated, as stated in the report, is 474,000 gallons daily, it will amount to 173,010,000 a year, costing about $1 for each 13,600 gallons of sewage said to be clarified.

The works built at the foot of Ferguson ave. are similar in design and management, but are over double the size of the Wentworth street works. They have six settling tanks double the length of the three at the smaller works, and double the amount of machinery and appliances. They cost $42,000 to construct and are said to be capable of clarifying 3,000,000 gallons of sewage daily. We have no data to show the cost of management of these works, but experience would show that they will at least cost forty per cent. more than the works having less than half the capacity. They commenced operations early in March this year, and will be worked with one set of men 10 hours per day, as at the Wentworth street works. If then 3,000,000 gallons arrive at the works daily the average per hour will be 125,000 gallons, and for the 10 hours the works are in operation 1,250,000 gallons of sewage treated and 1,750,000 sent forward to the bay untreated per day. The Hamilton newspapers reported that a test was made by the engineer and part of the committee to prove the amount of sewage that actually came to the works, and they found that it amounted to 2,200,000 gallons per day at the Ferguson ave. works, or 800,000 less than the capacity of the works is stated to be. The population served by the two works is probably about 35,000 and the united cost of operating the two works 10 hours per day will be $30,600 per year, over 87 cents per head of contributory population, and if worked night and day, as they ought to be, the working expense will be double that amount, less interest on capital.

The sewage leaves the sewer and flows to a well, and is then lifted out by centrifugal pumps about 20 feet high and discharged into a wooden trough that leads it to the brick culvert that feeds the settling tanks. During the passage of the sewage from the pumps to the culvert lime an alum solution is dropped into the stream at the rate of $3\frac{1}{2}$ grains of lime and $1\frac{1}{2}$ grains of alum for each gallon of sewage. All the settling tanks stand full of sewage in a quiescent state, and the volume of sewage pumped enters the top of the settling tank through an opening about four feet wide, at a speed to all appearances of about twenty feet per minute, floating over the surface of the fluid at rest in the settling tank to the opposite end, when it passes through a similar opening made in the partition wall between tanks Nos. 1 and 2, then floats back to the commencing end, where it enters tank No. 3 and repeats the process until all the six tanks have been traversed, when it falls into the discharge culvert that is connected with a covered-in drain, which we suppose conveys it to the bay.

We expect that the stream of moving sewage will not sink more than one foot into the quiescent liquid contained in the tanks, or spread out over the surface more than 8 feet, and the rapidity of the flow will prevent the lightest solids held in suspension from settling down, so that the sludge extracted will be chiefly the heavy harmless grit or scouring dirt from roads, yards and floors, and the solids from the sewage that is allowed to rest in a quiescent state in the tanks, while the bulk is flowing over the top. The alum was observable in the pressed sludge cake which had a clayey feel; but ammonia or urine usual in domestic sewage was not noticeable.

When comparing the sewage entering the tanks with the effluent leaving the last tank, No. 6, there was little difference in the appearance of the two samples, probably, first, because the flow was too rapid; second, because the sewage enters the settling tanks at the top when it ought to enter the bottom; third, because the precipitants are not in sufficient quantity or thoroughly incorporated before they enter the tanks; and, fourth, the lime solution is made from unslacked lime which will cause it to be attracted by the water rather than by the dirt composing the sewage.

We were informed that some improvements would shortly be made, and probably filters added to purify the sewage after clarification, as the engineer has been experimenting with great success in purifying sewage on Mr. Garfield's principle of passing it through pea coal, on the lines laid down in the September issue of The Canadian Engineer. The design and arrangements of the works are such that they can perform efficient clarification, and when filters are added and the whole sewage that comes to the works treated and the overflow weir becomes useless, except when a big storm is in progress, then the $80,000 and cost of management will become a reasonable outlay, though just as good results might have been secured at a far more moderate cost.

The culvert carrying the effluent from the tanks to the bay should be open and made broad and shallow, so that the effluent could secure aeration during its progress to the bay and be easily inspected; also the by-pass channels and overflow weir should be open to view, so that they could be easily observed and show when all the sewage was passing through the works. Sewage, during and after treatment, requires all the atmospheric air it can secure. It is hard for a deputation to get at the true value of any sewage works in a two hours' visit, because any works or process can be made to work efficiently for a short period, but the difficulty is increased if the bypass, the discharge channels and overflow weir are not all open to sight. Moreover the assistance of an expert analyst should be had to show the exact contents of the effluent.

As previously stated in articles in The Canadian Engineer, to clarify sewage it should remain at rest for some time, and if the continuous flow system be adopted, to save expense of a regular attention, then both ingiving and discharging flow should be thin and very slow, so that the volume of sewage resting is only very slightly disturbed and no perceptible motion created. The flow should be at a rate of about half a foot per minute, entering the full width of the settling tank near the bottom at the deepest end, and overflowing over a level lip the full width at the opposite end, and the quantity allowed to enter should be so regulated that it would be three hours before it reached the overflow. The Hamilton tanks can easily and cheaply be made to work on the continuous flow plan, and they can, as at present arranged, be worked on the quiescent system. Each settling tank would then work separately, as they ought to do, to perform good clarification.

We believe that each of the six long tanks at Ferguson avenue holds about 127,000 gallons; so to clarify 3,000,000 gallons in 24 hours the sewage should enter each tank at the rate of 170 gallons per minute, which would be sufficiently slow when the width of the tanks is taken into account. This should answer almost as well as the quiescent system worked with the float and discharge valves that are attached to each tank. When raw sewage enters at the bottom of a settling tank during the act of rising to the surface the suspended solids are encouraged to stay behind at the bottom.

Lime should not be used as a precipitant when the clarified sewage is discharged unfiltered, because it will not destroy microbes, but rather assist in multiplying them, and after a space of about two days, when the sewage effluent has mixed with fresh water, the lime will assist the clarified sewage to set up putrefaction, and the result will be equal to, if not worse, than would have been the case if the sewage had been well screened and passed in raw and untreated. The most suitable precipitant is stated by Mr. Slater, an expert in the sewage business, to be salts of manganese, which carry down the organic together with the dissolved suspended substances. It also destroys certain impurities by transferring to them a continual supply of oxygen from the atmosphere and from the air in the sewage fluid. This precipitant was expensive, but Mr. Adeney has found a substitute, by utilizing the waste products from certain iron works that are very rich in manganese, and which contain all the valuable properties claimed to be in the manganese compound sold as a sewage precipitant. An equally good precipitant may be made from the rust of iron, from iron ores or the refuse oxide of iron discharged from sulphuric acid works, dissolved by hydrochloric acid, which, when manufactured, is called perchloride of iron; ¾ of a pound will precipitate 1,000 gallons, it will never set up decomposition, and has great settling power. It could be made at a cost of $15 per ton.

With reference to the manufacturing of a solution of lime for use as a precipitant, we have found that the lime should first be slacked in thin layers with about 7 per cent. of water sprinkled on with a fine rose sprinkler, just sufficient to cause the lime to separate into fine powder, then bank it up into a heap and cover it over to keep in the steam, and allow it to remain in that position for over a week, or until it becomes thoroughly cooled. Afterwards mix it with the fluid at the rate of two parts fluid to one of lime, and mix it together well, when a solution is produced that is heavy enough to bear down and be attracted by the solids held in suspension by the sewage, and if the lime is delivered into the fluid sewage at the rate of eight grains or over of slacked lime to each gallon of raw sewage, and the lime solution is delivered into the sewage at the point where it enters the works, so that the action of the pumps and sharp angle movements will thoroughly incorporate the lime solution with every particle of sewage in equal proportions, and then the sewage is allowed to rest motionless for a short time, the lime will settle to the bottom of the tank, leaving a colorless clarified fluid behind it. But if sufficient be not put in, and it is not properly mixed with the sewage, or the solution is made from hot fresh unslacked lime, then it becomes saturated with the fluid, and does little or nothing towards compelling the dirt to separate from the water of the sewage.

It can be easily found out when the lime is properly incorporated with the sewage by filling a clear glass vessel with the sewage from the point where it enters the tanks. The liquid will appear full of small globules or flakes similar to the air during a heavy fall of snow. If the fluid is allowed to quietly rest in the glass, it will be seen that the flakes settle down to the bottom, leaving a clear fluid, which, though beautifully clear, is strongly tainted by urine and lime, and if preserved in a bottle it will soon be seen to ferment and change color, proving that it needs filtering, and that lime should not be used to clarify sewage if that sewage is discharged unpurified into fresh water. The

THE CHEMICAL AND METALLURGICAL BUILDING, McGILL UNIVERSITY

sewage at Hamilton did not show the presence of the precipitant when I examined it.

We have gone into the details of Hamilton sewage works as we found them when we had the privilege of inspecting the plant and process, and have used the printed reports of the city engineer to get at the expenses, and so give our readers the facts in regard to the purification system that is held up as a pattern, though the cost per head of population for construction of the plant is over $2.25, and the annual cost of management, including interest on capital, shows at least 75 cents per head for clarifying less than half the daily run of sewage. Granting that the sewage is really efficiently clarified, if purification filters are built and the sewage after being clarified is purified, then the cost to the ratepayers will be almost twice the present amount; and should all the sewage be handled that flows to the works the cost may be increased by one-half again, so that a stiff bill will have to be paid by those who adopt this system.

In Europe many millions of dollars have been wasted in the erection of useless and inadequate works, many fine-looking plants have been built and operated to mislead and keep the people quiet, by pretending to do a work that they certainly were not doing, and glowing and misleading reports have been published about them. But careful inspection by the government officials has shown these works in their true light. All the defects and the reasons for these expensive failures in Europe have been published, and Canada can have the benefit of the Old Country's fifty years' experience and experiments for nothing. She can avoid the expensive works and pitfalls, and adopt systems that have cost large sums of money to discover. It is a remarkable fact that the systems so far adopted by Canadian towns are the ones that are the most expensive and the least efficient of a majority of the methods at present in use in Europe.

Jos. Walker, of Parry Sound, Ont., fireman on an engine on the C.A. & O.A. & P.S. Railway, was instantly killed in a rear end collision last month near Parry Sound.

The bill to incorporate the Nickel Steel Company of Canada, provides that the company, with the consent of the Governor-in-Council, may lease or purchase the following lines of railway: Bay of Quinte, Central Ontario and Irondale, Bancroft and Ottawa Railway.

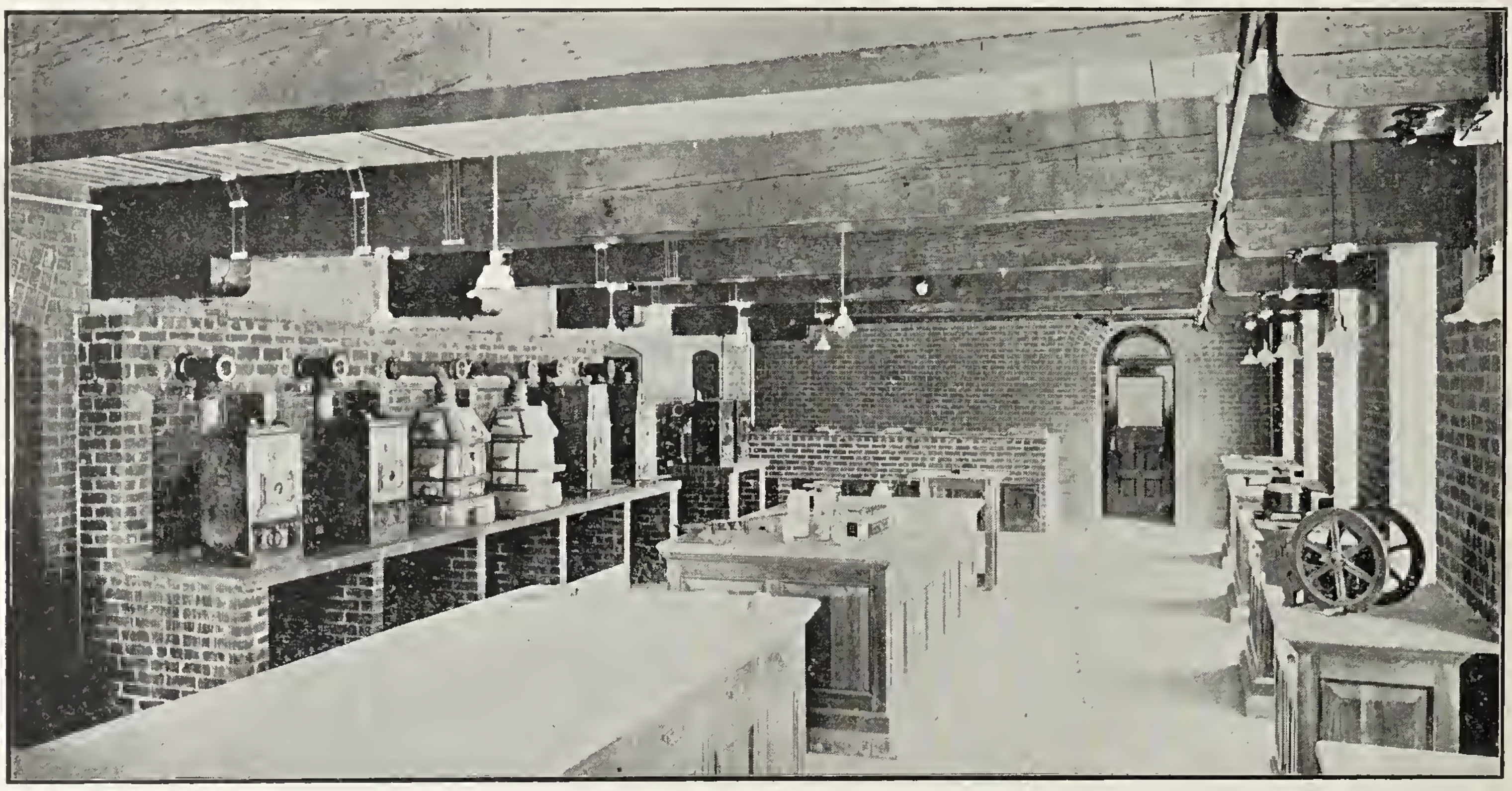
McGILL UNIVERSITY.

McGill University is one of the world's great universities, not only because of the massive piles which shelter its lecture rooms and laboratories, and the great money value which they represent, but on account of the standing in the world of intellect of the men connected with it and the enthusiasm which they bring into their academic work. The university is a monument to the liberality and public spirit of a large group of Montreal's most distinguished citizens. The first of these was Hon. James McGill, who, dying in 1813, left the manor of Burnside to endow a university in which one college was to be called McGill. From this beginning the present flourishing institution has grown up, and the original endowment has grown by gifts from private individuals from one hundred and twenty thousand dollars to almost four millions of dollars.

CHEMICAL AND METALLURGICAL DEPARTMENTS OF McGILL UNIVERSITY.

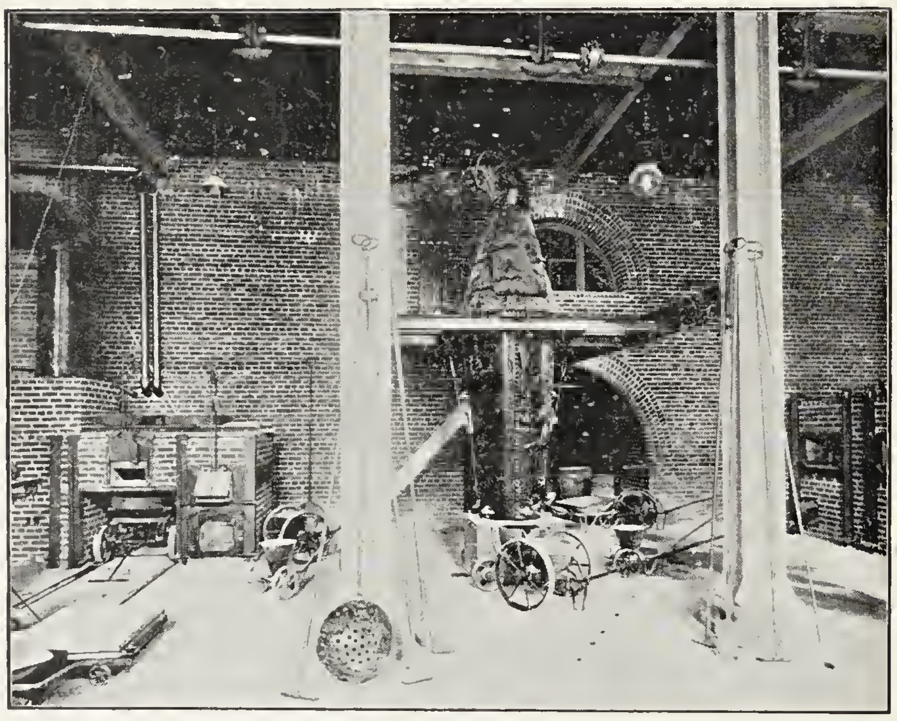
On the authority of Dr. W. C. Roberts-Austin, C.B., chemist of the British Mint, McGill University has now the best equipped metallurgical laboratory in the world. A similar remark might be applied to the mining department which has been in operation since March 1st. The mining department of McGill is splendidly housed in the McDonald Chemical and Mining Building, as shown in the accompanying engraving. The building is five stories in height, with basement and sub-basement. Extending from either side, at the back, are two large wings rising as high as the top of the ground floor. In these and in the rear part of the building are situated the principal rooms devoted to mining. There are the ore dressing room or mill, the smelting room, the metallurgical laboratory, the assay laboratory, wet assaying rooms and the teaching departments. These occupy a floor space of about thirteen thousand square feet.

The ore-dressing room has a twenty-foot ceiling and occupies the whole north wing. Here the ores of silver, copper, etc., and gold-bearing quartz in the condition in which they leave the mines, are received, and turned out metals in a form suitable for the furnace-room. The ores of gold, silver, copper, lead and iron are most important—but others can also be treated by this plant. It is full size



Assaying Room—Mining and Metallurgical Dept.—McGill.

and differs from the ordinary mine equipment in that it is much more extensive. The usual commercial plant is designed as a matter of course to treat the ore of one mine, but the McGill appliances are sufficient to treat any kind of ore found in the Dominion of Canada. The student trained here will thus be at home with any first-class mining plant, and the plant at McGill being devoted to research and investigation only, unlike the average commercial plant, will be the means of producing many improvements in the methods of ore treatment now in vogue. The equipment consists of three rock crushers, known as "Blake," "Dodge" and "Comet" machines; two batteries of stamps, one of five five-hundred-pound heads, the other of two of a thousand-pound heads each; a Huntington mill; coarse and fine crushing rolls; trowels and sieves; Hartz and Collum jigs, revolving, bumping and belt tables, and various pieces of apparatus such as magnetic separators, etc.

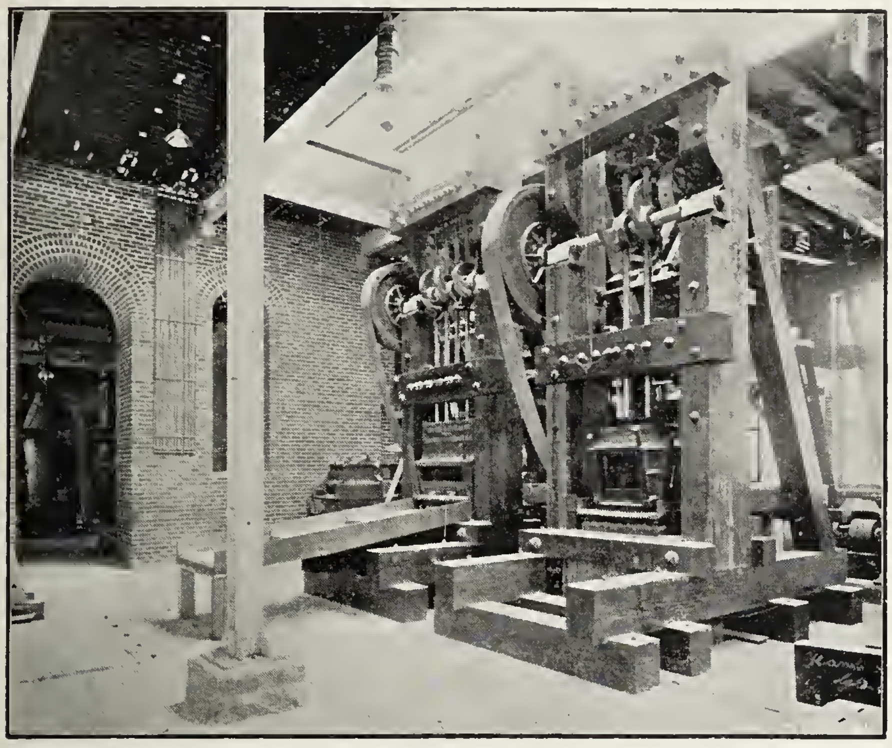


Furnace Room—Mining and Metallurgical Dept.—McGill.

The crushers reduce the large fragments of rock to make easier the separation of the metal. The machines consist essentially of jaws moved by levers of great power. Into these the large pieces of ore fall, and are broken to a size convenient for the separating machines. The crushers are set in a high platform, the ore being carried up to them by means of a bucket elevator. The broken-up product of the crushers drops down, and is received in trucks which are capable of being rolled along the floor, or being hoisted up and moved about by the overhead system of travellers. According to its kind, the ore on leaving the crushers is carried to the stamp batteries or to the Huntington mill. Into either of these machines it is fed by an ore-feeder. In the stamp batteries the ore is pounded by swift blows from heavy hammers until it becomes a powder. Then, if it is gold ore, the mixed powder of gold and rock is passed into a quantity of mercury in a pan. The gold forms an amalgam with the mercury, and is held while the valueless rock is taken out. The heavy blows of the stamp battery are borne by a huge block weighing many tons, which extends deep into the earth. The Huntington mill accomplishes the breaking up of the ore in another manner, The ore being fed in falls into a heavy, tub-like receptacle, in which are four heavy iron disks attached to a shaft, in the centre, which revolves rapidly. The disks are so attached that they are free to move toward or away from the centre within the limits of the tub, but centrifugal force caused by the revolution of the shafts keeps them against the sides of the tub, and they revolve as they move thus in a circle. The ore is thus moved about inside, and is ground up into small fragments.

The methods of separating the ore from the rock involve a number of interesting machines. The Frue Vanner is one of these. It consists of a wide continuous sheet of rubber, with turned-up edges, stretched upon two revolving cylinders. One cylinder is lower than the other, so that the plane of the rubber sheet is inclined slightly. The broken mixture of metal and rock is fed upon the central part of the incline, and moves up (the sheet moving in that direction), until it encounters a spray of water which impinges on the sheet and carries down with it the rock. The metal being of greater specific gravity, holds its place on the sheet in spite of the water, and is carried until automatically washed off into a basin prepared for it. The jig separator is fed from three large hoppers connected to a revolving screen immediately above it. Through all its compartments water flows continually, and the ore is separated and sorted into the several qualities according to its specific gravity and size. The amalgamator and settler are rather complicated instruments, which extract gold from the slime resulting from previous separating processes.

As a preparatory process to treatment on the Rittenger table or Evans Buddle the pointed box may be used. This is a series of boxes or basins of conical shape, and varying in size. The sand from the stamp battery is fed first into the smallest box, through which a stream of water is flowing so swiftly that only the largest grains are allowed to sink. The remainder is carried into the next larger box or basin, where the water spreading out has a less velocity, and the next size of grain is deposited, and so on.



Stamps—Mining and Metallurgical Dept.—McGill.

The Evans table serves to concentrate slimes and fine sediments on a circular bottom. It is a large round table sloping from the centre. As the table revolves the slime is fed upon it at the centre and flows toward the circumference, leaving in its progress the heavier portions of its constituents, while the surface is continually swept smooth by means of revolving brushes. Thus the particles of different densities are arranged in concentric circles, and can be carried by properly directed jets of water each into its proper receptacle.

The Rittenger table is a huge inclined plane of plate glass, which is jerked abruptly from side to side and mixed pieces of ore are sorted as they travel down its inclined surface, water flowing along with them. The repeated jerks cause the heavier pieces to travel steadily away from the lighter, and eventually the two come off the table at opposite corners. A good deal of the ore reduction machinery is supplied by Fraser & Chalmers, Chicago.

Adjoining the ore-dressing room is a second very large room used as the smelting room. Here the ores will be roasted or smelted, which ever is necessary. The room will contain an English cupellation furnace, a reverberating roasting furnace, a Bruckner cylinder and a twenty-inch water-jacket furnace, as well as two-pot furnaces, each eighteen inches in diameter. Part is the tool room, and alongside is a small motor to run the machines in the immediate vicinity. The lowest floor of the south wing is taken up by the assaying rooms. In the dry assaying room are fourteen assaying furnaces of the best and latest pattern. Opening from it is the balance room. The apparatus of this room is of the sort commonly used in chemical laboratories, and the rooms themselves are nicely finished with white and buff-colored enamelled brick.

Balance Room—Mining and Metallurgical Dept.—McGill.

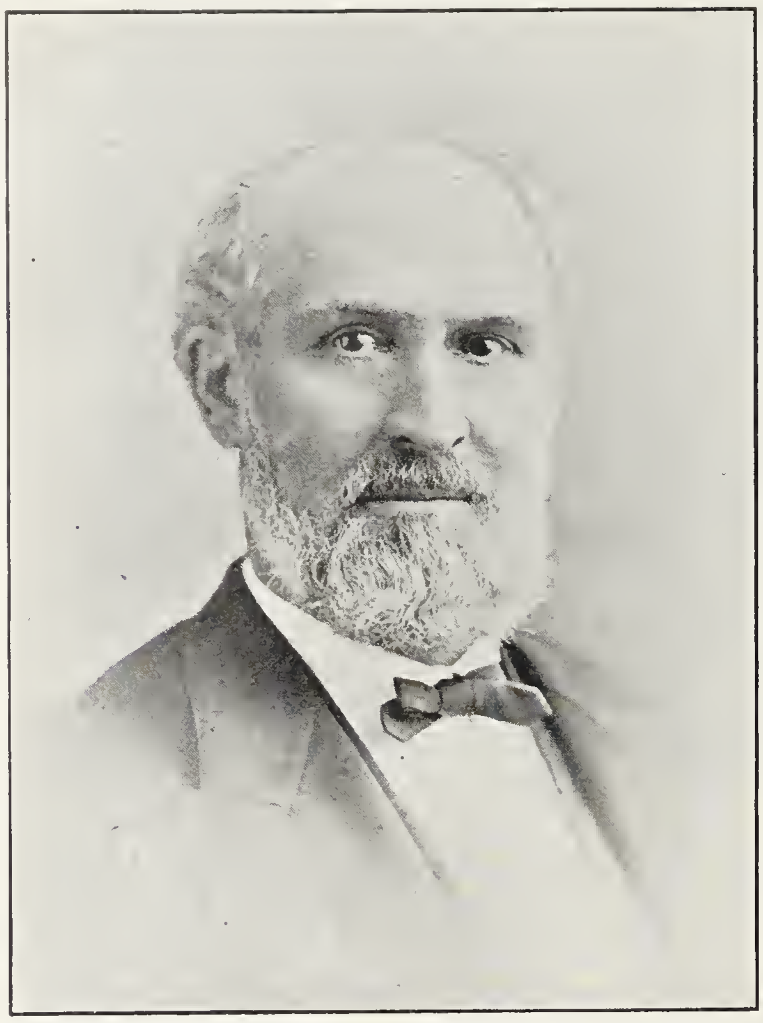
The portion of the building devoted to teaching, and designing and drawing rooms, is admirably arranged. The lecture room is fitted with numerous appliances for demonstrating the subjects taught, including an electric lantern for illustrations. Adjoining this is the office of Dr. Porter and his private research laboratory.

The portion of the building occupied by the chemical department is spacious and well equipped, and the ground floor and first basement floor are lecture theatres constructed on the latest plans. Throughout the buildings are lofty ceilings, ample lighting and modern appliances for ventilating and guarding against fires. On each of the three floors above the ground floor, extending all across the back of the building, is a large room—each of which is fitted up as a chemical laboratory, with every convenience and appliance which has been suggested by the experience of all the largest chemistry schools in the world. In addition to an unusual accommodation in the line of draught cupboards for the carrying off of unpleasant or poisonous gases, there is a system of large flues in every part of the building connected to large ventilating fans in the roof. A noticeable convenience is a store-room on each floor adjoining the elevator. On the first floor in front are the offices of Prof. Harrington and his assistants and a commodious library and reading-room.

A Lecture Room—Mining and Metallurgical Dept.—McGill.

Among the many citizens of Montreal who have given largely for the provision of educational facilities in that city, none has been more generous in giving, nor has any one made wiser disposition of his gifts, than W. C. McDonald, whose endowments of McGill University now amount in buildings and funds to almost two millions of dollars, being more than has been given by any other Canadian to any educational cause.

Mr. McDonald is the youngest son of the late Hon. Donald McDonald, some time President of the Legislative Council of Prince Edward Island, and is grandson of Capt. John McDonald, 8th chief of the Clan Macdonald of Glenaladale, who after founding the Scotch settlements at Tracadie, Scotchfort, Glenfinnin and Fort Augustus, P.E.I., served during the American Revolutionary War as a



W. C. McDonald.

captain in the 84th or Royal Highland Emigrant Regiment. He was born at Glenaladale, Tracadie, P.E.I., 1833, and was educated at the Central Academy, Charlottetown, also obtaining his business training in that city, under the late Hon. Daniel Brennan. He left P.E.I in 1854, and removing to Montreal became an importer and general commission merchant there. Subsequently, he embarked in business as a tobacco merchant and manufacturer, and now owns the largest tobacco factory in Canada. He is a governor of McGill University, a governor of the Montreal General Hospital, and a director of, as well as the largest shareholder in, the Bank of Montreal. He is an honorary member of the Architects' Association of Quebec. Among his gifts to McGill are : $20,000 to the Thomas Workman endowments for mechanical engineering; the erection and equipment of the W. C. McDonald engineering building, valued at $350,000, and an endowment for its maintenance ; the endowment of the chair of Electrical Engineering with the sum of $40,000 ; the erection and equipment of the Physics building, valued at $300,000, and two chairs of Physics, with endowments amounting to $90,000; the endowment of the Faculty of Law with $150,000 ; a further sum of $150,000 for the maintenance of the engineering building ; $50,000 towards the endowment of the Pension Fund, and the erection of a new building for the department of chemistry, mining and architecture, at a cost of $500,000.

The Goldie & McCulloch Co., of Galt, Ont., have shipped a big Wheelock engine to the Montreal Belt Line Railway Company. The engine weighed 19,440 pounds.

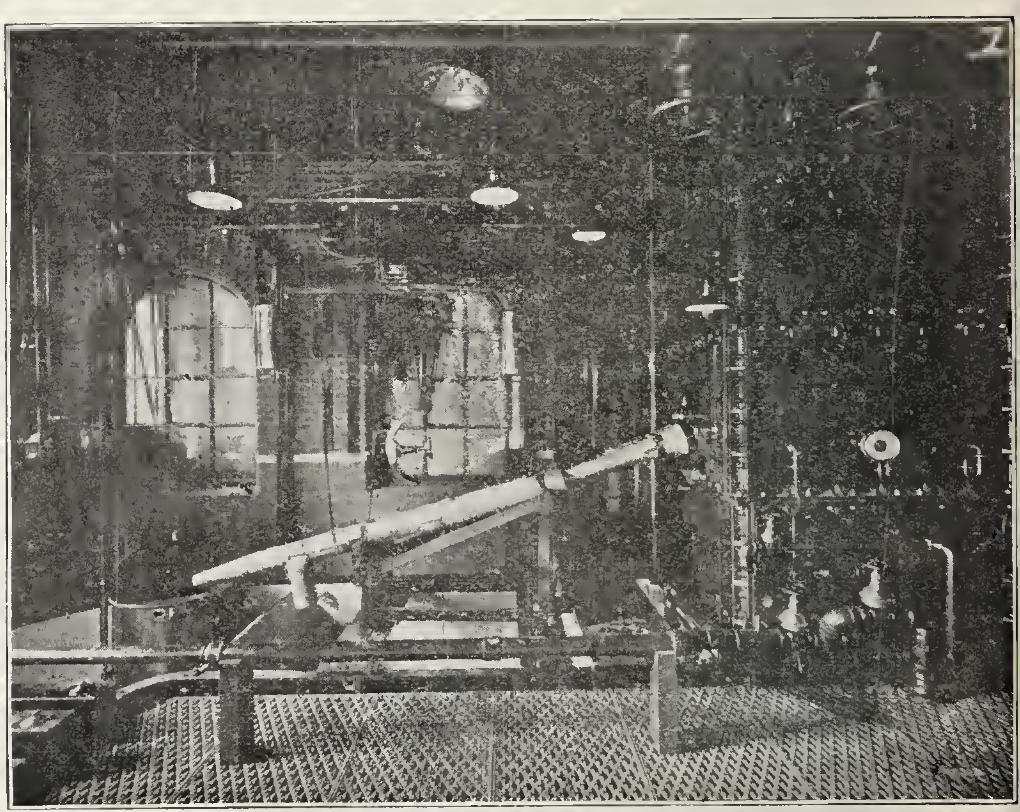
The Montreal and Southern Counties Railway Company, which obtained its charter last year, has been given power to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville, and bonding powers increased from $20,000 to $25,000 a mile, in addition to preference stock, $10,000 a mile. There are extensive powers for connecting with other railway companies or crossing the St. Lawrence, and for amalgamating with other companies, but the company is debarred from running along the streets of Montreal or adjoining municipalities. Powers are also given to run steamers, maintain pleasure grounds, and sell electricity for light, heat or power.

HYDRAULIC LABORATORY, M'GILL UNIVERSITY.*

BY HENRY T. BOVEY, M. INST. C.E., LL.D., ETC., AND J. T. FARMER, MA E.

The laboratory is 39 feet in length and 31 feet in width. On the north side, near the centre, stands the experimental tank, having its base on a level with the bottom of a flume. The flume, which is 5 feet wide and 3 feet 6 inches deep, runs from the tank and terminates in an adjustable weir. The water flowing through the flume may pass over or under the weir and may run to waste or may be made to pass into five large carefully calibrated tanks, 8 inches below the floor level and ranged in series on the south side of the laboratory. The covering of the tanks is on the level and forms part of the floor. Over the easternmost of the tanks stand the experimental pump on a base formed of suitably designed carrying girders or trunks. The section pipes descend into the tank and thus allow the water passing.

On the west side, at convenient points along the flume, are the following pieces of apparatus: A 16-inch Pelton wheel, with brake attachments, a turbine tester of special design and an experimental centrifugal pump. Along the west wall is fitted up a Rife hydraulic ram with all the necessary pipes and tanks for experimental work. The pumps are driven from a line of 3½-inch steel shafting near and running parallel with the east side of the laboratory. The shafting is operated by a 100 h.p. Mackintosh & Seymour high-speed horizontal engine, standing in an adjoining room. By means of an electro magnetic coupling, designed by Prof. Carus-Wilson, and connected with a switch conveniently placed near the experimental pump, the main shaft can be almost instantaneously thrown in and out of gear, and without sudden impact or shock, as the circular armature permits a partial rotation until the resistance is overcome. A 90 h.p. automatic recording transmission dynamometer is placed on the shaft between the magnetic coupling and the nearest point at which power is transmitted. An 8-inch line of piping makes a complete circuit of the laboratory near the ceiling. The several pumps and motors are connected with this circuit, and the movement of the water is controlled by suitably placed 8-inch straightway valves, branch tees, elbows, etc. By means of a short vertical length of 8-inch piping, terminating in a goose-neck, the pumps can be made to discharge into the top of the experimental tank, from which the water passes into the flume, then into the large tanks, and is thus again available for supply The whole of the water used in the laboratory is drawn from the city high level reservoir, which gives at the base of the tank a pressure of more than 120 lbs. per square inch. The city service is connected with the 8-inch circuit, which can therefore, if desired, be made to act as a supply pipe to the turbines and other motors. Provision is also made for connecting the latter directly with the city service. The pumps and motors all discharge into the flume, and the water then passes over the weir where the volume of discharge can be measured. If the volume is not too great, it can be at once measured by passing the water into the large calibrated tanks.



The weir may be used the whole width of the flume without side contractions, but by means of suitable cheeks one or more side contractions can be introduced and the width of the weir diminished to any required extent, or the weir may be subdivided into two or more independent weirs. A large number of experiments have already been made to determine the co-efficient of discharge with and without side contractions, and with different depths of water over the weir lip. The results will be given as soon as the experiments have been completed. The water may be conveyed to any one of the five tanks through an iron channel provided with properly placed manholes, and the five tanks can all be connected together by means of a 10-inch pipe running along the bottom of a deep trough next the wall, and having the necessary valves and 6-inch branches communicating with the several tanks. The water may also be run to waste through this 10-inch pipe. In this channel and next the weir there is a flap-door with edges inclined at 45° to the vertical. The edges of the gap closed by the door are also inclined at 45° to the vertical, and the fit between the door and gap has been made as perfect as practicable. An india rubber cord is inserted in an endless groove running along the centre line of the edges, so that when the door is closed and pressed home it is absolutely water-tight. The door can be instantaneously opened and closed by means of a lever and a system of links acting as a toggle-joint, and each movement is recorded by an electrical chronograph. In any given experiment the door is opened and the water allowed to run to waste until the head over the weir lip is steady, when at a signal the door is instantaneously closed, when the water is conveyed by the channel into any or all of the tanks.

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*Extracted from a paper read before the Canadian Society of Civil Engineers.

The stand-pipe for the fire-hose rises vertically at the back of the tank and extends to the full height of the building. At the base it is provided with a number of unions varying in size from six to one inch, and to these unions are attached the lines of piping for pipe-flow experiments. The position of the stand-pipe was selected so as to allow of straight lengths of more than 400 feet of pipe being used. To secure a uniform pressure a Locke Regulator has been provided, which responds, though slowly, to a variation in the pressure. A special piece of apparatus for hose testing has been placed in the south-west corner of the laboratory. It is connected by hydraulic piping with the Blake pressure pumps in the testing laboratory. A large number of tests have been made on the strength, and on the longitudinal and circumferential extensibility of different varieties of hose, which in the great majority of cases was in lengths of 50 feet. The pressure, which often exceeded 800 lbs. per square inch, was directly indicated by a standard Crosby gauge, while the time and pressure were also registered automatically by a recording gauge specially designed for this work.

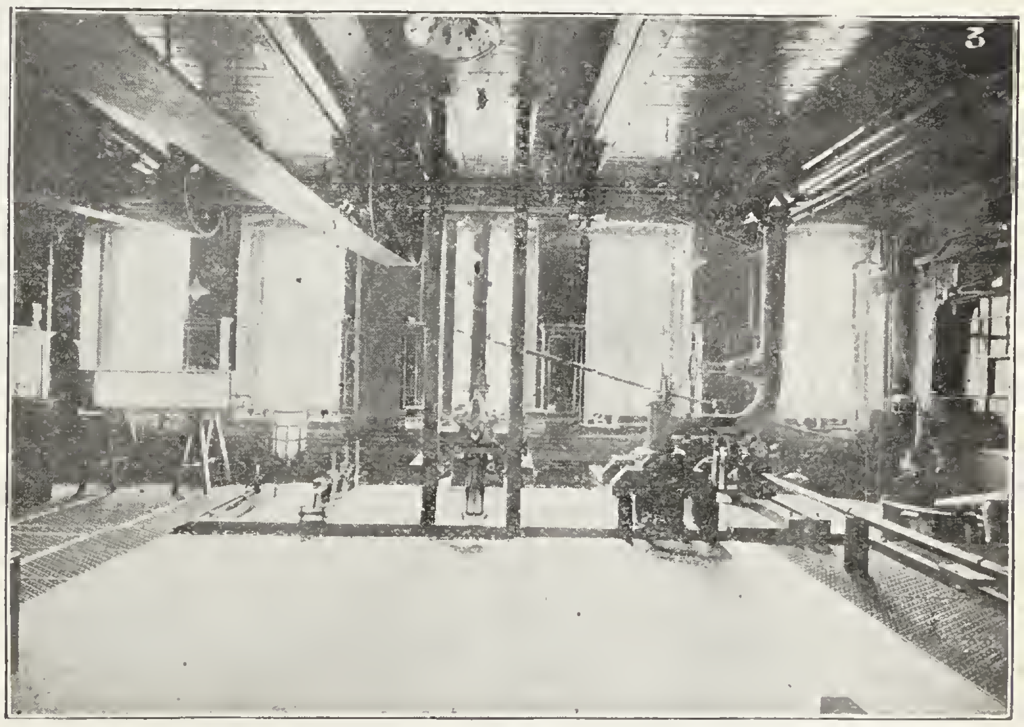
Of the remaining apparatus the following may be briefly noticed :—

A glass tank, 72 inches by 18 inches by 12 inches, with circular diaphragm chamber at one end. This serves to illustrate vortex ring motion, and also, with the aid of glass tubes with flared ends and of different diameters, the critical velocity and other stream-line phenomena. Inverted glass domes, with an orifice in the bottom, with which are demonstrated the phenomena of circular and spiral vortex motion, of the inversion of the vein, etc. A series of very carefully made nozzles with a perfectly smooth bore, and having pressure gauge attachments at each end. Each nozzle is 36 inches in length between the gauge connections, and has a taper corresponding to a diameter, varying from 3 inches to 2¾ inches in the largest to 3 inches to ½ inch in the smallest. A series of sixty hydrostatic gauges, each with a range of 20 lbs. and embracing pressures up to 140 lbs. per square inch. The gauges are graduated to tenths of a pound, and the range of every gauge is overlapped by the two consecutive gauges. A mercury column 27 feet in height, is fixed to the north wall near the experimental tank, and in addition to this there are several small portable mercury columns, which are used in the experiments for determining the resistance to flow in small pipes due to elbows, bends, convolutions, etc. These pipes are 13 in number, have a smooth bore and are ⅜ inch in diameter. The laboratory is also supplied with a Venturi and other piston and rotary meters, a number of hook gauges, Darcy's improved Pitot tube, brass standard gallon, quart and litre measures with glass strikes, etc., etc.

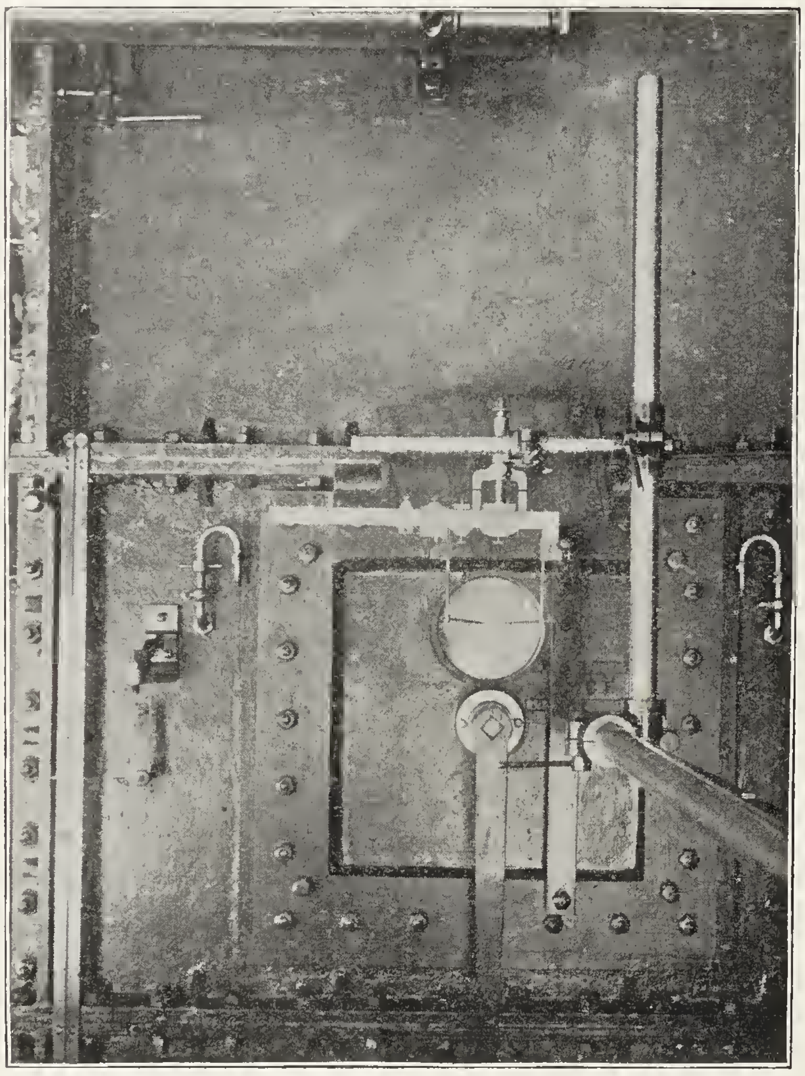
There are several copper measures of capacities varying from 10 to 100 gallons. They have been carefully calibrated, and the calibrations are frequently checked. When in use they are placed upon a plane-table with adjustable feet so that a true level can be always maintained. Each of the large tanks already referred to is 6 feet by 3 feet 6 inches by 9 feet deep, and discharges into the 10-inch header through a 6-inch straightway valve. Each tank is also connected with a separate vertical 4-inch brass pipe, in which the water freely rises and falls with the water in the tank. This forms the float chamber. These tanks have been carefully calibrated, and the contents can be readily measured to within the sixteenth of a gallon. The float is attached to a vertical $\frac{3}{16}$-inch brass rod with a pointer at the upper end, indicating on a brass plate the quantity of water in a tank. A fine cord, fastened to the top of the rod, rises vertically, passes around a frictionless pulley, and carries a constant weight at the end which counter-balances the rod, etc., keeps the cord taut, and so prevents the pointer from rubbing against the plate.

The experimental tank is of cast iron, is 28 feet in height, square in section, and has a sectional area of 25 square feet. Every care was taken to make the inside surfaces of the tank walls perfectly flush, and to this end the flanges, by which the several sections were bolted together, were placed on the outside.

The impact apparatus was constructed for the purpose of determining the force with which jets from orifices, nozzles, etc., impinge upon veins of different forms and sizes. A massive cast-iron bracket, 8 feet in length, has one end securely bolted to the front of the tank, and the other supported by a vertical tie-rod from one of the oak beams in the ceiling. The upper surface is provided with accurately planed slides, which are set level about 5 feet above the orifice axis. If, from any cause, the end of the bracket farthest from the tank is found to be too high or too low, the error can be corrected by loosening or tightening the nut on the tie-rod. The balance proper is carried by a sliding frame, which can be moved horizontally into any position along the bracket by means of a rack and pinion actuated by a sprocket wheel with chain. At one end the frame has two equal arms with a common horizontal axis parallel to the bracket, and each arm has a stop on its lower surface which serves to limit the oscillation of the balance. The balance, in its mean position, consists of a main trunk with horizontal axis rigidly connected with a vertical slotted arm and with two equal horizontal arms at one end. The common axis of the latter is horizontal and perpendicular to the axis of the main trunk. The hardened steel knife edges of the balance are 4 feet centre to centre, and rest in hardened steel Vees inserted in the ends of the sliding frame on each side of the bracket. The bottom of each Vee is in the same horizontal line (called the axis of the Vees) at right angles to the bracket. A bar with the upper portion graduated in inches and tenths has a slot in the lower portion, which is bent into a circular segment of 9½ inches radius The bar slides along the slot in the vertical arm of the balance. A radial block, with the holder into which the several vanes are screwed, moves along the slot in the circular segment, and may be clamped in any required position, the angular deviations from the vertical being shown by graduations on the segment. The centre of this segment in every case coincides with the central



point of impact on a vane, is in the vertical axis of the balance arm, and is also vertically below the axis of the Vees. Thus the jet can always be made to strike the vane both centrally and normally. The scale pan hangs from a knife-edge at one end of the horizontal arms of the balance, while to the other end is attached a fine pointer, which indicates the angular movement of the balance on a graduated arc fixed to the sliding frame. The balance is in its mid-position when the pointer is opposite the zero mark. When a vane has been secured in any given position, the preliminary adjustment of the balance is effected by moving a heavy cast-iron disc along a horizontal screw fixed into the main trunk. The sensitiveness of the balance is also increased or diminished by raising or lowering heavy weights on two vertical screws in the top of the trunk.

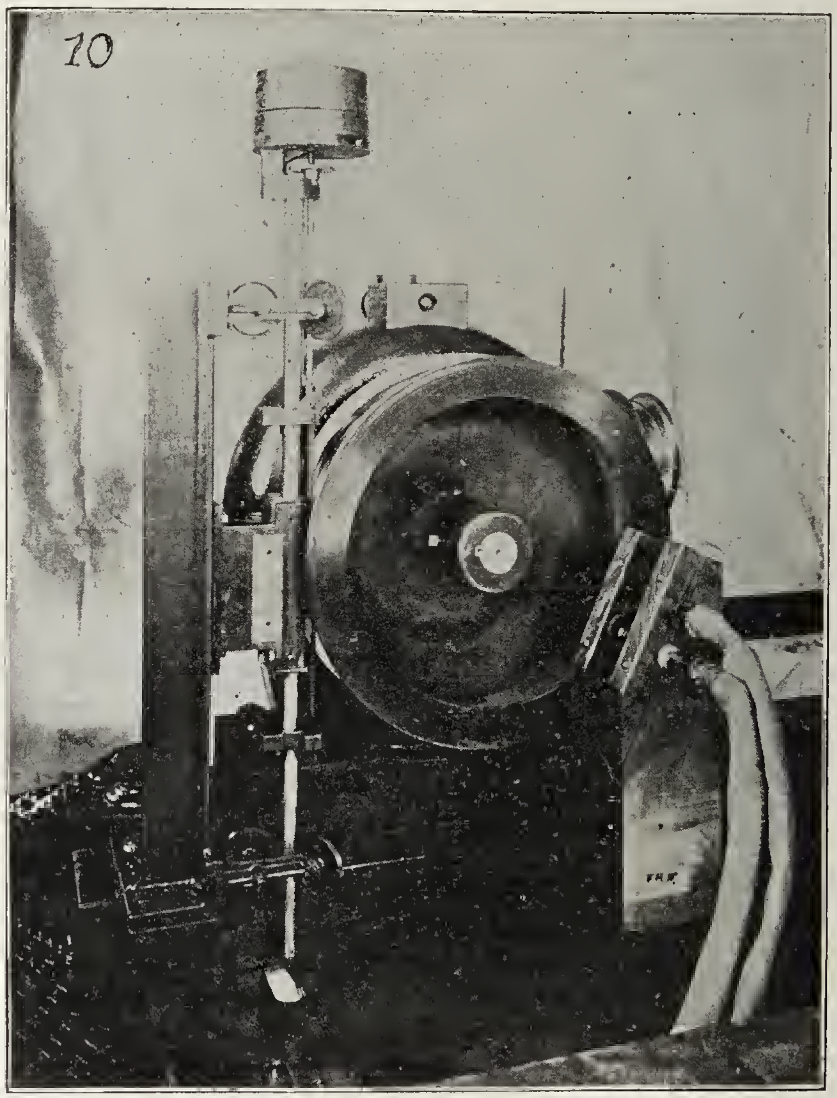


In motor testing it is often of importance to know the pressure of the water at certain points in the supply (or delivery) pipe, and, generally speaking, it is impracticable to employ either a mercury or a water gauge. The pressure is therefore observed by standard Bourdon gauges, of small individual range, which are frequently tested, a record being made of the errors. The method usually adopted to diminish the oscillating effect of the gauge of the fluctuation in the flow is to connect the bore of the pipe with an annular chamber by a number of small holes. In the McGill Laboratory these holes have been replaced by a continuous opening around the bore, less then .005 inch in width, with the obvious result of obtaining a better mean pressure. Similar chambers are also being used in experiments on the resistance of bends to flow. There are four sets of bends of 1 inch, 1½ inch, 2-inch and 3-inch diameter, and each set consists of 30 bends, 10 having a radius of one diameter, 10 of two diameters and 10 of four diameters. At the central cross-section of each bend, provision is also made for ascertaining the pressure, either by a mercury column or by a gauge, at the extremities of the radii to the outer and inner surfaces of the bore. The chambers for the bends are combined with union couplings, of the same bore, which allow the attached part to be swivelled through any required angle.

The speed of the motor is taken by a revolution counter and also by a tachometer. A sliding slotted sleeve at one end of main shaft of the motor can be made to engage with the spindle of the revolution counter, which can therefore be readily thrown in and out of gear at the commencement and end of a test, and the readings can be taken at leisure. The tachometer is supported on a bracket fixed to the motor frame, and is driven by a cord passing over a pulley on the motor shaft.

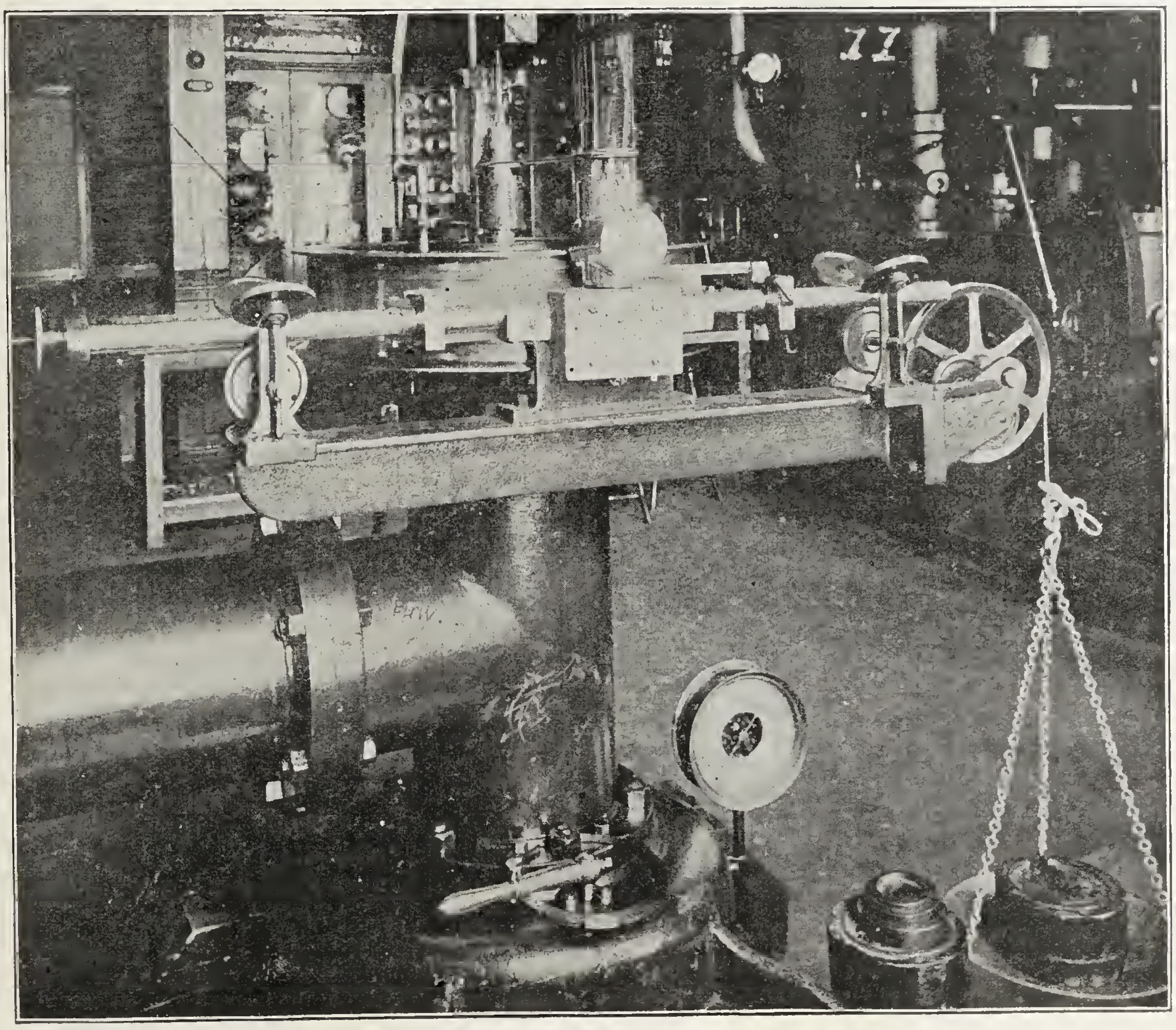
Besides a Halpin brake of 50 h.p. capacity, the laboratory is equipped with a friction brake which has been designed by Mr. Withycombe, the superintendent, and which can be used with wheels both of the horizontal and the vertical type It possesses many novel features of which the most important are :—That it is self-adjusting, and that a single direct weighing gives the total drag. The brake wheel is of cast-iron and finished on a lathe. The outer and inner surfaces of the rim are shrouded, the shrouding on one side being formed by the solid disc connecting the rim with the boss. A stream of water is delivered tangentially into the channel inside the wheel through a narrow rectangular mouthpiece of nearly the same width as the channel. The surplus water is carried away by a scoop of somewhat similar form but reverse in action. The tight portion of the brake band is of leather, and the slack portion consists of two strips of copper. In the mean position, each portion embraces about one-half of the circumference of the pulley, and its end is attached to a lug projecting from a rod. The lug to which the slack portion is joined is capable of sliding along the rod, and by means of a screw, can be adjusted so as to increase the slack tension as desired, and therefore to produce any required total drag. The rod in the direction of its length has a practically frictionless range of five inches, which corresponds to a variation of about 16° in the angle of band contact. The resultant force along the rod is the difference between the tight and slack tensions, and measures the drag. The force is balanced by dead weights which are placed in a tray at the top of the rod for a vertical wheel, and if the wheel is horizontal, in a scale-pan suspended by a cord which passes over a frictionless pulley and is attached to the head on the rod.

If from some cause, the band friction should increase, the drag would also increase, and there would be a corresponding movement of the rod. Thus a portion of the leather band would be unwrapped, while an equal portion of the copper band would be brought into contact. But the frictional co-efficient for leather exceeds that for copper, so that the drag would be less and would continue to diminish until it again balanced the weight. The reverse, of course, would be true, if the band-friction should diminish. The rod would move in the opposite direction, an excess of the leather band would be brought into contact and the drag would continually increase until equilibrium was again restored. Hence, within a certain range, the band will find a position of equilibrium, although the friction may vary, and the total drag will then be measured by the dead weight in the tray or in the scale pan. If the movement of the rod should be so great that it may come against one of the stops provided to limit its action, the drag can be readjusted by means of the screw attachment. This, however, is very unlikely to happen, as the range already allowed is sufficient to admit of a large variation in the value of the co-efficient of friction. It has been found that the best results are obtained by running the wheel without any lubricant on the rim ; care should be taken to protect the rim from water or oil, which would necessarily produce a considerable variation in the frictional resistance. This brake has been in use only a few months, but in the several trials which have been made it has fully realized the expectations that had been formed of its efficiency. It has been employed in measuring directly off the jack shaft the power developed by a 6-inch turbine with vertical axis and a 16-inch Pelton wheel with horizontal axis.



The whole of the water is discharged into the flume, and passes over the weir into the large calibrated tanks. If the quantity is too great to be measured in the tanks, the water is run to waste and the discharge calculated from the normal weir formula. Co-efficients of discharge have been found for various depths over the lip, and the co-efficient for any particular depth can be very approximately determined by interpolation. The depth over the lip is obtained by means of the "depthing" apparatus, which consists of a deep girder stretching across the flume and carrying three hook gauges with Verniers which read to .001 inch.

The centrifugal pump is erected over the flume in a framework which allows it to be raised or lowered so that the heights of suction and discharge may be varied at will. For this purpose the piping is made in interchangeable lengths of 2 feet. The pump is driven by a 9-inch belt and discharges into the ceiling circuit already described. From this circuit the water is delivered into the top of the experimental tank, flows into the adjoining flume, passes over an intercepting weir for calibration and is then again conveyed along the flume to the pump. Thus, the same water can be used over and over again.



The turbine is supported upon an angular flange bolted to the bottom of a cast-iron cylinder. An 8-inch tee is secured to the crown of the cylinder, and a cover with a specially designed gland is bolted to the upper flange of the tee. The jack-shaft passes through this gland, which forms an almost frictional bearing. No packing is required, as provision has been made for carrying away any slight leakage that might occur. The jack-shaft passes through a piece of pipe screwed to the bottom of the cover and extending downwards to the cylinder, so that it is protected from the impulsive effect of the inflowing water. The supply pipe is connected with the horizontal branch of the tee, and the entrance of the water is controlled by an 8-inch straight-away valve placed at some distance from the opening. The gates of the turbine, for example, one of the New American inward and downward flow type, are worked by means of a shaft extending from a pinion geared to the toothed quadrant and passing through a gland in the crown of the cylinder. The upper end of the shaft is provided with a handle and pointer, which indicates on a graduated quadrant the extent of the gate opening. Suitable pressure gauge connections have been arranged in the upper and lower parts of the cylinder. The power of the turbine is determined by the friction brake already described.

The experimental pump is of the vertical triple-throw single acting plunger type, and is driven by two 10-inch double leather belts running on 48-inch pulleys formed on the outer crank throws, or discs. The plungers are 7 inches in diameter and have an 18-inch stroke. The approximate maximum delivery is estimated to be 1,000 gallons per minute when the pump is running at a speed of 150 revolutions per minute against a pressure of 120 lbs per square inch. The suction valve chambers are placed directly over the calibrating tank nearest the east wall, and draw the water from this tank through two 10-inch suction pipes. Each discharge valve chamber is directly connected with a 12-inch header, which discharges into the 8-inch ceiling circuit. The water may be made to flow in almost a direct line to the point of discharge, or it may be made to pass around the three sides of a rectangle so that the effect of the additional bends and increased length of piping may be estimated. The water flows into the experimental tank at a point 20 feet above the level of the discharge valves.

One of the features of the pump is the provision made that the valves can be taken out and replaced by others of a different type. The valves at present in situ are a Riedler valve and two with groups of 36 circular disc valves of 1⅝ inches diameter in each. In addition to the usual pressure gauges, tachometer and revolution counter, the pump is fitted with a specially designed continuous triple indicator apparatus, which autographically records during any given time of a trial the speed, variation and duration of the valve chamber pressure at any point of the stroke. Sight holes are provided for observing the movement of the valves and indicators for recording their lift. A special recording gauge also registers the pressure in the delivery pipe. As the pump is for experimental work, it has been made unusually heavy, its total weight being about 55,000 lbs. The plungers, valves and valve seats, all internal screws, nuts, etc., are of bronze, and weigh more than 3,700 lbs.

TORONTO AND SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER :

SIR,—On March 17th, Jno. McDougall, of the Detroit Purification Company, who pushes the old system of the International Water and Sewage Purification Company, of London, England—which company has within the last two years improved its methods by making its filtering process into an intermittent, in place of a continuous flow system, thereby purifying the sewage by bacteria which require atmospheric air regularly at short periods—appeared before a special committee of the Toronto City Council and described the method of treatment, and also showed blue print drawings of the precipitating tanks and filters that they adopted. The plan of the tanks and full information we have before published in the October and November issues of 1896, and the March and May issues of 1897.

Mr. McDougall's remarks showed that his company keeps to the old methods of continuous flow both in the settling tanks and filters, while his principals in England have been compelled by the sanitary inspectors to march with the times and adopt the intermediate system. This system is about the most expensive one that can be adopted, and includes some intricate sludge machinery that soon gets out of order and is really unnecessary because the sludge will come away better without it. The ferrozone precipitant necessary to this system would be a heavy, constant and useless expense. The polarite used for the filtrate is said to cost $30 per ton, and it is now a recognized fact that screenings of coal that only cost $2 50 per ton, are far more efficient and lasting when used as a filtrate, standing ahead of every other material except charcoal made from wood or towns' garbage. On page 326 of the March, 1897, issue of The Canadian Engineer, there is a table showing the cost of sewage disposal in twenty towns of England. The last one, Swinton, is worked on Mr. McDougall's plan. Of this town, Mr. McDougall's company states that there is 16,000 population, the average daily sewage is 300,000 gallons, that they can give their sludge away, that their tank capacity is 240,000 gallons, that the plant cost $30,000; it costs $3,000 each year to manage it and pay for ferrozone. The population of Toronto is over twelve times that of Swinton, and Dr. Sheard said that there will be a much larger quantity of sewage per head discharged in Toronto than in British towns. In that case our sewage works may cost about $360,000 for plant, and $36,000 per year after, and then we might have to provide sludge presses and furnaces to burn the sludge cakes in addition.

Mr. McDougall was ably supported in showing the advantages of his company's system by Mr. Warner, who had come all the way from Nottingham, England. He is the patentee of the Low Temperature, Slow Burning and Natural Draught Garbage Destructor, which has been fully described in page 286 of the last February issue of The Canadian Engineer. When answering a straight question put by Ald. Lamb, Mr. Warner stated that the Toronto garbage destructors were similar to the ones he built twenty years ago, and it will be admitted that the high temperature fume consuming, quick burning and heat raising destructors are five years ahead of the low temperature ones, so that Toronto must be a quarter of a century behind similar towns in this line of sanitary appliances. The saying of the late Benjamin Franklin, viz., "Be careful that you do not pay too much for your whistle," is applicable when a sewage scheme is under construction.

Expert.

Toronto, May 15th.

CEMENT IN ONTARIO.

During 1897 the cement industry in Ontario has made satisfactory progress, as shown in the report of the Bureau of Mines. Both the natural rock and Portland cements are showing a large increase of production, and manufacturers are establishing a good reputation for the qualities of the cements they are putting on the market. The increase, however, is not shown in the number of establishments, which are two less now than four years ago; but in number of men employed and amount of wages paid for labor, in quantity of cements produced and in their value there is a gratifying evidence of progress. The number of men employed in these four years has increased from 168 to 231, the wages paid for labor from $44,878 to $89,060, the quantity of cement manufactured from 85,903 barrels to 181,495 barrels, and the value of the cement from $109,834 to $246,425. The greatest increase, however has taken place in the production of Portland cement, which has gone up from 30,580 barrels to 96,825, while the natural rock cement has only increased from 55,323 barrels to 84,670. In value natural rock cement shows an increase of $27,349, while the Portland cement shows an increase of $109,242. This, no doubt, is largely, if not chiefly, owing to the growing interest in the building of good roads in our towns and cities.

All of the natural rock or hydraulic cement works are now situated along the Niagara escarpment, extending from Queenston, near the Niagara River, to Limehouse, on the main line of the Grand Trunk Railway.

One of the Portland cement works is situated at Shallow Lake in Grey county, where the business is carried on by the Owen Sound Portland Cement Company. New machinery was added during the past year, and new buildings and more kilns are now in course of erection which, when completed early this summer, will bring the output up to over 300 barrels per day. The product of the works is known as the Samson brand, and the manager states that not a single complaint was received last year regarding the quality of the material put upon the market. Both the marl and the clay used in the manufacture of cement at these works are obtained from the bed of Shallow Lake.

The works of the Rathbun Company at Napanee Mills were also enlarged last year, and they have now an estimated capacity of about 350 barrels per day. The plant embraces the latest and best developments in Portland cement making, and is constructed with a view to produce material of very uniform quality. The clay and marl are mixed in proportions carefully regulated by chemical analysis, and the slurry is so finely reduced in the mixing mills that it will all pass through a seive of 100-mesh, or 10,000 holes per square inch. Two new burning kilns were erected last year, making three in all; they are of the continuous type, and produce a very uniform well burnt clinker. In the grinding mill the clinkers are ground to an extremely fine powder, and, so finished, it is conveyed to bins in a new storehouse, which has a capacity of 50,000 barrels. The Rathbun Company's cement is known as the Star brand, but they are now producing a quality called the Silica Portland. The marl for the works is drawn from an extensive deposit on the line of the Bay of Quinte Railway, and the clay from a property adjoining the works.

During the fiscal year ending June 30th, 1897, Canada imported 210,871 barrels of Portland cement, valued in the Trade Returns at $252,587; so there is yet considerable room for expansion in the industry at home.

PNEUMATIC GRAIN-HANDLING MACHINERY.[*]

BY FREDERIC ELIOT DUCKHAM.

The grain trade of the world has been steadily increasing, and the bulk of the cargoes and the tonnage of the vessels is now so great that the time consumed in unloading and the cost of keeping the vessel in docks are very serious considerations. To deal with such a large amount of trade, the old method of working by hand has been gradually replaced by the use of various machinery, such as the endless band, carrying a number of comparatively small buckets travelling at a speed of about 100 feet per minute in an enclosed trunk, and which has for some years been in use in America, in Liverpool and elsewhere; but where the cargoes to be discharged are of a mixed character, e.g., general goods and packages in the 'tween decks, and grain in bulk in the lower hold, it has been found more convenient to use hydraulic cranes with self-opening and closing grabs, or buckets filled by hand and self-discharging, or other contrivances with which to lift the grain, but which can at any time be exchanged for slings or hooks for the discharge of the ordinary merchandise. In all these methods, however, it is only possible to reach such of the grain as is within the area of the hatch; the other portion, which may extend 100 ft. or more fore or aft, has to be trimmed to the hatch by manual labor or by the so-called steam shovel. Grain is often brought in bunkers and other confined spaces in which it is not practicable to employ either of these machines, and so the grain in these places has to be filled into sacks and unloaded by manual labor. But when one has to deal with present-day vessels of 10,000 tons capacity, representing a capital expenditure of £70,000, and a debit of £70 for each day in dock, it is of very great importance to increase by every possible means the speed with which their cargoes can be loaded or unloaded. In this direction the skill of the naval architect has been shown, and must still continue to be shown, in so designing the vessels that they may not only be safe and otherwise satisfactory for navigation, but present the greatest facilities obtainable for the receipt and delivery of their cargoes.

It is also of importance that such improvements be made in the machinery employed that the greatest amount of work may be done in the shortest time and at the lowest cost, with safety. It was with such requirements in view that the author directed his attention to the employment of air for elevating and conveying bulk grain. There was no originality in this idea—air under vacuum, as well as under pressure, had from time to time been tried in this country and abroad for this purpose; but several difficulties presented themselves and prevented the successful operation of the machinery. Prominent among these were the difficulties of sucking or forcing grain in bulk through pipes, of getting the grain out of any vacuum chamber into which it had been drawn, and of separating the grain and its dust from the air which had conveyed it. The author feels that he need not give in uninteresting detail the various steps by which these and other difficulties were overcome, but would at once refer to two types of pneumatic elevators now in successful operation. One of these is employed for the discharge of sea-going vessels overside into barges at the Millwall Docks and the Albert Docks, London, Bremerhaven, Hamburg, etc. In these the machinery is afloat in a hull of, say, 80 feet by 24 feet by 10 feet; in each the machinery under deck consists of a compound engine connected direct with air-exhausting pumps capable of producing and maintaining a partial vacuum 15 inches of mercury in a tank into which, say, 5,000 feet of air, under atmospheric conditions, is being admitted per minute. The boilers are of the ordinary marine type; the engines are surface-condensing. On the deck of the craft, one, or in some cases, two or three towers are erected each to support a vacuum tank, which acts as a grain receiver, and is say, 10 feet in diameter by 16 feet high. This tank is coned at the bottom, and has connections for two or three pipes through which the grain is drawn with the current of air from the hold of the ship. An automatic air-lock is fitted through which the grain discharges itself from the tank into the hopper of the weighing machines, and after weighing, it flows into the barge in bulk, or it may be sacked and delivered in that way. The men required for the discharge of, say, 100 tons per hour, are an engineer, a stoker, one man to each of the pipes, a leading hand, and three others for moving barges and general work. The coal consumption is about 5 cwt. per hour. This is heavy compared with the coal consumed by the ordinary bucket elevator, but as this pneumatic machine effects a direct saving of the cost of trimming the grain to the hatchway, the comparatively greater coal consumption sinks into insignificance. In fact, the whole operation of discharging is often less than what would have been the cost of trimming alone.

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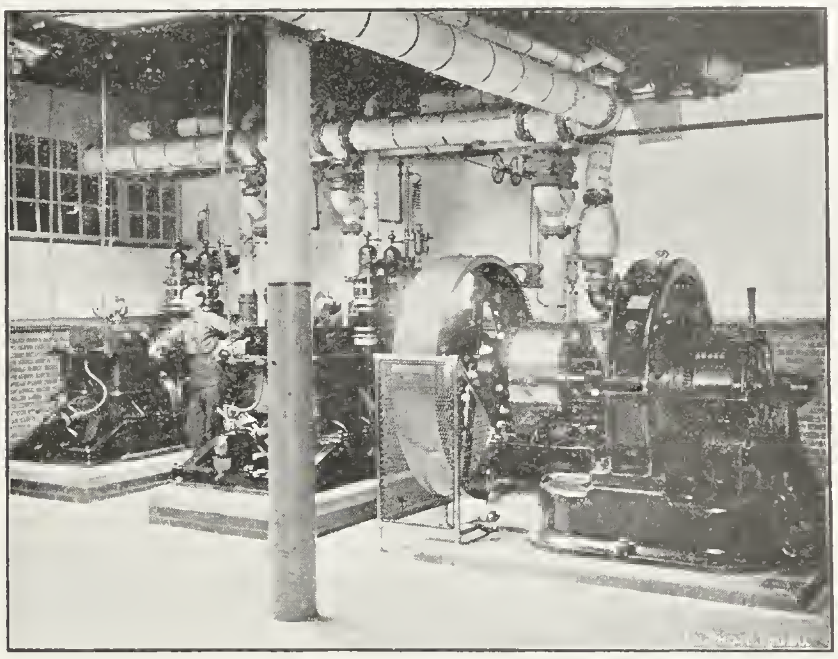
[*] From a paper read before the Institution of Naval Architects.

The pneumatic machine has moreover other advantages; it is worked in all weathers; it not infrequently happens that the pneumatic grain elevators are the only ship-discharging appliances at work on a wet day on the Thames. In addition to this important saving of the ship's time, it is also to be noted that the suction pipes, being suspended from the elevator derrick, can be lowered into the ship's hatchway and the discharge commenced within a few minutes of the machine being brought alongside. There is none of the usual loss of grain in handling, as the cargoes are conveyed within closed conduits from the discharging ship into the receiving barge, and the grain is, moreover, improved by such intimate contact with the conveying air. This is specially so when the grain is heated and out of condition. The suction pipes, which are semi-flexible, can be taken by any tortuous route into the bunkers or other confined spaces, and the grain can be drawn out therefrom almost as readily as from the ship's hold. There is obviously an entire absence of the dangers to life and limb that are inseparable from the ordinary lifting machinery. The elevator vessels are fitted with steam capstans to assist in moving themselves, as well as the barges that come alongside for loading.

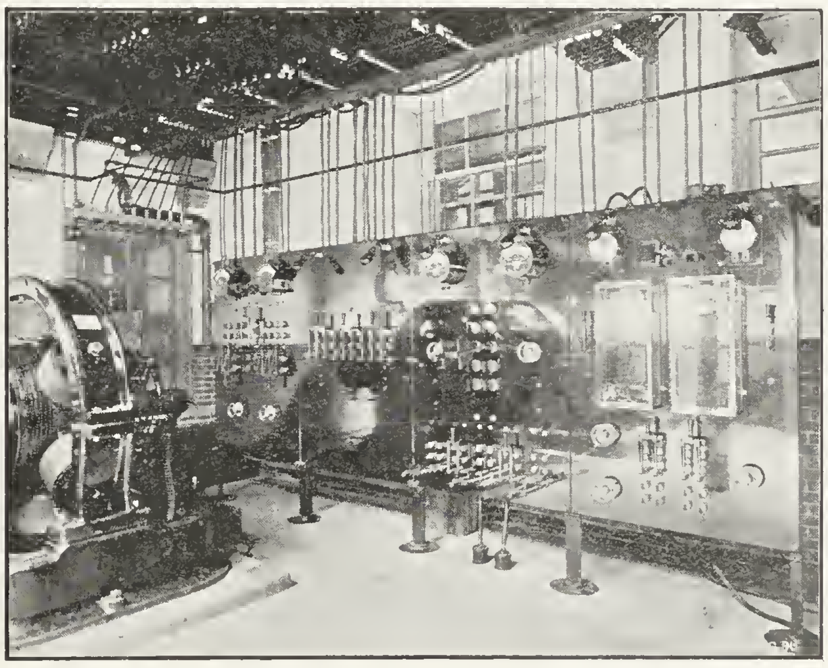
IMPROVEMENTS IN THE ELECTRICAL PLANT AT McGILL UNIVERSITY.

The university has again to thank W. C. McDonald for generously defraying the cost of extensive alterations and additions to the light and power station, connected with the faculty of applied science. The equipment is now installed in a handsomely finished well-lighted room, and consists of a 30 k.w. Edison-Hopkinson dynamo, and a 30 k.w. Siemens dynamo, each driven by a Willans high speed engine; the dynamos are on the shaft of the engine, making what is known as direct connected units. These two machines are capable of lighting the different buildings of the university, supplying current for more than 3,000 lights. The dynamos are run in series on the three-wire system, or if the load is light, one can run on the two-wire system. In addition there are installed a 100 h.p. Goldie & McCulloch engine, directly coupled to a 75 k.w. General Electric dynamo. This machine is set apart for power purposes, the motors in the building averaging about 110 h.p. It may be also used for lighting purposes when the demand exceeds the capacity of the two former dynamos. The switchboard is made of dark slate in panel form, and it is said to be one of the finest in Canada. The lighting of the buildings at night is effected by the help of accumulators. The accumulator room, standing beside the dynamo room, possesses two batteries of Crompton-Howell storage cells, of a united capacity of 800 ampere hours. These batteries would discourage the antagonism of the adversaries of accumulators, for they are subjected to all kinds of discharges, and after a usage of over six years have an all-round efficiency of 72 per cent. An ingenious arrangement, devised by Louis A. Herdt, lecturer in electrical engineering, enables one battery to be taken out of circuit, and the other one to be put in circuit during the night, as soon as one of the batteries shows signs of being discharged. The plan of the new dynamo room is such as to permit of the plant being extended so as to light any further buildings that may be erected or any of the existing buildings, such as the Library and Museum, which are at present lighted from other sources.

L. Herdt, B.A.Sc., E.E., Lecturer in Electrical Engineering, McGill University.



Electrical Plant—McGill University.



The Switch Board—Electrical Plant at McGill University

To increase the educational advantages of the mechanical engineering department especially, two of the battery of four Babcock & Wilcox boilers have been replaced by a boiler of the Lancashire type, and one of the Locomotive type. Both the new boilers were made in Canada, one by John Macdougall, the Caledonia Iron Works, Montreal, and the other by the Robb Engineering Co., Limited, Amherst, Nova Scotia.

SEWAGE DISPOSAL BY SUBSOIL IRRIGATION.*

By E. Mohun, M. Can. Soc. C.E.

In October, 1894, the author received instructions from the Hon. the Chief Commissioner of Lands and Works to devise some means for disposing of the sewage of Government House, Victoria, B.C., and though the work undertaken is but on a small scale, he trusts that it may prove of interest. It was found that the sewage of the building had been disposed of by the simple expedient of running a 6-inch pipe across a field and discharging into the street ditch, thereby creating an intolerable nuisance. The sewerage system of the city had not been extended in that direction, and to make connection with the nearest point it would have been necessary to construct a sewer about 3,600 feet long, nearly all the trenching for which would have been through solid rock. The contour of the ground being adapted to the purpose, it was decided to dispose of the sewage by subsoil irrigation. Reference to the books of the water department showed that the house consumption as taken by metre was remarkably small, frequently not exceeding 300 gallons a day.

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* A paper read before the Canadian Society of Civil Engineers.

The only pipes available were 6-inch circular drain pipes, T pipes, and 3-inch circular drain tiles. At a convenient point in the field the old sewer was cut, and an automatic flush tank built, from which the sewage passed down a tight 6-inch conductor to the inlet ends of the 3 inch drain tiles.

In laying the drain tiles the following method was adopted: Contour lines having been set out with the level and the trench cut along them, bricks were laid with a carpenter's level 8 feet long, so as to form level and solid bearings beneath the ends of the drain tiles laid upon them.

The connection with the six-inch conductors was made by turning down a 4 × 6 T, and making connection with the drain tiles by means of a galvanized iron taper. The ends of all the drain tiles are provided with air vents, made by galvanized iron, and connected with the drain by quarter bends. The area irrigated is nearly one acre, and it has not been found necessary to underdrain, as the whole of the discharge appears to be absorbed by the earth. The total length of the drain tiles is 1,463 feet, and from their upper surfaces are from 10 to 12 inches below the ground surface. Their alignment is marked on the ground by lettered stakes. The flush tank is provided with an L screen, ¼ mesh, divided into three compartments by weirs; into the first the sewage discharges directly through the old pipe; as the screen becomes clogged with paper it overflows into the second compartment and similarly into the third. It has not been found necessary for the scavenger to clear the screen more often than once in six weeks, though for other reasons it is done once a month. No offensive smell can be detected either at the flush tank or on the lines of pipes, nor is there any indication of excrement sodden soil. The gardener states that the ground never before produced vegetables equal to those grown since the sewage system was installed.

The ground to the north-west is considerably higher than the field and garden, and is very rocky. Shortly after the completion of the work, snow fell, and within a few hours a rapid thaw took place accompanied by heavy rain, the water actually running over the surface in a sheet. Under the circumstances the tile drains became surcharged, and when the rush from the flush tank took place it can hardly be considered wonderful if three or four of the tiles were broken. They were of course easily replaced, and a similar occurrence guarded against by cutting an intercepting ditch across the field to lead the surface water into the street ditch. An object sought to be arrived at was to so proportion the tank that each discharge would fill all the drains, practically, simultaneously.

The cost of labor was high, a good deal of rock being met with in laying six-inch conductor. The work was performed by day labor under the author's instructions, and its cost was: Material, $255.68; labor, engineering, etc., $244.30; total, $499.98.

THE POSSIBILITIES FOR SMELTING IN BRITISH COLUMBIA.*

BY R. A. HEDLEY, NELSON, B.C.

My knowledge of the country and my study of its ores enables me to make certain statements, which I feel myself qualified to make somewhat authoritatively. My data, however, are insufficient to handle the subject very thoroughly.

Lead smelting offers some difficulties for any plant possible with present production of the lead producing mines. First, its capacity would not warrant the erection of a complete refinery, and without it lead must be refined in the United States, paying a duty of two cents per pound, while lead in ore pays but 1½ cents per pound. As the bulk of the lead ore shipped is of high grade (over 65 per cent. lead) this renders it difficult to compete with the smelters of the United States, as the difference in freight paid is but slight. To illustrate this point, let us suppose that ore is shipped to the United States carrying 65 per cent. lead. Assume freight at $8 per ton, duty is $19 50, making $27.50. Smelted here, bullion shipped at same freight rate will pay $5 20 and duty will be $26, making $31.20. It would seem, then, better to leave a high grade lead ore severely alone, unless the product can be disposed of to better advantage than by refining in the United States, paying duty on lead. Suppose a 40 per cent. lead ore shipped; it will pay freight, $8, and duty, $12, making $20. Smelted in this country and bullion shipped, freight will be $3.20 and duty on lead $16, making $19.20.

This is in favor of smelting as regards these two items of cost. Now the ores carrying 40 per cent. lead or less are as yet but a small item, and generally speaking carry a high percentage of zinc, or else the gangue is a barren silica, making fluxing costly.

The production of the whole Slocan district may be roughly stated at 100 tons per day, of which 60 per cent. is of high grade, over 65 per cent. lead, and 25 per cent. at least, carries fully 15 per cent. zinc. The question of flux is an important one in considering the treatment of these ores. Lime is very abundant, of good quality and cheap, but iron oxide of fair purity does not occur, and metallic iron as scrap is procurable in but limited quantity at the rate of $15 per ton. The ores of Rossland district have been spoken of as suitable for fluxing lead ores, but that is a very questionable point. An average Rossland ore will carry excess silica, and no little arsenic, and they strike me as an expensive flux when the cost of roasting is considered. Also the difficulty of making a good roast cuts some figure in the cost of treatment. A complete roast on a mixture of galena and pyrites, enables one to charge a certain proportion of raw galena ore, a manifest saving. Until recently, I was firmly convinced that a blast furnace matting plant would handle the ores of Rossland camp very economically and to great advantage. I still believe so, though I consider the difficulties are not few.

I have no definite information regarding the treatment of Le Roi ore at the Trail smelter. Would like to be able to state to what degree of concentration they attain, and what proportion of calcined ore they use on the charge. Having analyzed samples from many of the mines, I am of the opinion that, given an assortment of ores from different mines, matte smelting can be successfully and economically carried on. The consumption of fuel and flux should be kept very low, and as these two items form by far the major portion of the cost of first concentration, it is of importance to determine whether 10 or 15 per cent. is necessary. A year ago I was told that they were using but 10 per cent. of coke, and I analyzed a piece of slag produced without extraneous flux, finding:—

Silica	49.2 p.c.	Gold .045 ozs. per ton.
Ferrous oxide	23.2 p.c.	
Alumina	14.9 p.c.	
Lime	5.7 p.c.	
Magnesia	5.4 p.c.	

It would be very interesting and instructive to see pyritic smelting thoroughly tested on these ores, with a well adapted plant. It may be said that pyritic smelting has never yet proven a success, but it has never yet had a fair trial. In Newfoundland, it has been stated that purely pyritic smelting was successfully carried on, but the ore treated, if I understand aright, carried very little slag forming material, and therefore, the concentration was low. Professor James Douglas made a trip expressly to see that plant in operation. Robert Sticht wrote at length on the subject, and described the operations of plants at Boulder, Kokomo and Toston, stating that there were obvious reasons why they were not successful, either through faulty plant or ores unsuitable.

As yet we do not know what the Rossland mines are capable of producing. Wild statements have been made on this head, but I believe that a 500-ton plant, erected at such a point and run so economically that it could make a smelting rate of $7 per ton f.o.b., Rossland, would soon have to increase its capacity. If these ores will smelt with a concentration of 10 to 1, using 12½ per cent. coke and 10 per cent. flux (limestone), that figure will leave a profit to the smelter. Speaking of possibilities, however, I consider that they are far greater in the Boundary Creek district. There, the variety is greater, and a perfectly self-fluxing ore is obtainable. I do not pretend to say that there is an abundance of ore of such grade as to maintain a large plant but I do say that there is every indication that such will prove to be the case. Once transportation is had, development will be pushed and plants will follow. Ores will be treated, both by direct smelting for matte and by previous concentration. There are very clean ores of mixed pyrites, chiefly pyrite and chalcopyrite, that will carry 8 to 12 per cent. copper and low silica; others of low pyrites and gangue, that will form an excellent slag.

Should the coal, on development, prove to be of good coking quality and in sufficient quantity, a plant with large capacity will treat ore as cheaply as anywhere on the continent. Even bringing in coke at a cost of $12 per ton laid down, I have no hesitation in stating that a 500-ton plant (two furnaces) using steam power, will smelt at a cost not to exceed $2.75 per ton of ore. This of course will produce matte the grade of which will depend on the degree of concentration and the percentage of copper in the ore.

In order to get at the margin on treating a ton of ore, let us assume certain values, and figure the cost by shipping matte, and also converting to copper, and shipping for electrolytic treatment, assume:

4 p.c. copper, at 10c.	$ 8 00	
4 dwts. gold, at $1	4 00	
4 ozs. silver, at 50c.	2 00	
		$14 00

Shipping matte: 40 p c. copper, conc. 10 into 1.

Freight to New York	$18 00
Deduction: 3½c. per lb. copper	28 00
5 p.c. of silver	1 00
	$47 00

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* A paper read before the Federated Canadian Mining Institute.

Representing 10 tons of ore, or per ton..	$ 4 70	
Blast furnace treatment, per ton	2 75	
Losses, say 7½ p.c. (excessive)..........	1 00	
		$ 8 50
Leaving a margin to miner on $14 ore		$5 50

Or converting 40 p.c. matte to metallic copper.

Roasting and reverberatory furnace work, per ton of copper..................	$30 00		
Marketing one ton of copper........	40 00		
	$70 00		
Representing 25 tons of ore, per ton		$2 80	
Blast furnace treatment		2 75	
Losses on treatment, say 10 p.c. (excessive)		1 40	
		$6 95	
Leaving a profit to miner on $14 ore			$7 05

You will observe that for the purpose of facilitating these calculations, I have taken my copper value at 10c. per pound. It is customary to figure at $1 per unit, or 5c. per pound in ores, which would make this a ten dollar ore. That there is every indication that such grade of ore will be developed in enormous quantity, I am sure most mining men familar with the country will agree. With East Kootenay I am not familiar, but I believe that the range between Kootenay Lake and Fort Steele will produce ores that after concentration will materially assist smelting operations in the country. West again of Boundary Creek, in the Okanagan country, I have seen evidence of ores in veins of unusual size, that will yield handsomely. The coast too, if report be true, has its ores of character suitable for smelting, and exceptionally situated for economical treatment.

My figure on converting 40 per cent. matte to copper and marketing that, seems abnormally high, but it is based on roasting in the hearth furnace by expensive hand labor, and can be greatly reduced by automatic machinery. The New York market being the best, necessitates a high freight, and if all values are paid for they must charge a good treatment rate.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during April and the four months ending April, 1897, 1898:—

	Month of April.		Four months ending April.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£5,899	£2,694	£17,917	£8,112
Pig iron	. . ..	2,683	455	5,224
Bar, etc.	858	1,682	3,889	3,967
Railroad	9,504	50	13,351	6,972
Hoops, sheets, etc.............	4,608	1,817	11,009	5,470
Galvanized sheets	6,182	9,522	12,023	14,071
Tin plates....................	10,778	14,996	72 320	40,545
Cast, wrought, etc., iron	4,081	4,117	11,085	10,250
Old (for re-manufacture)	.. ..	495	572	898
Steel	4,752	3,486	14,987	19,421
Lead	712	1,602	2,782	4,305
Tin, unwrought	1,872	2,454	7,316	5,930
Alkali........................	3,667	6,042	8,189	11,558
Cement	1,110	3,503	2,953	5,491

CANADIAN ELECTRICAL ASSOCIATION.

The following is the programme of the convention of the Canadian Electrical Association, to be held at the Windsor Hotel, Montreal, this month:

BUSINESS PROGRAMME.

Tuesday, June 28th.—9.30 a.m.—Meeting of Executive Committee. 10 00 a.m.—Opening of the first session in Convention Hall, Windsor Hotel; President's address; reading minutes of last meeting; secretary-treasurer's report; reports of committees and general business. 2.00 p.m.—General business; presentation of papers; discussion.

Wednesday, June 29th.—9.00 a.m.—Consideration of reports of committees; election of standing committees; selection of place and time of next meeting; general business; presentation of papers; discussion.

Thursday, June 30th—9.30 a.m.—Election of officers.

LIST OF PAPERS.

"How to Overcome Some of the Difficulties Encountered by Central Station Men," A. A. Wright, Renfrew, Ont. (1) "The Unconscious Ownership of an Important Key"—(A Plea for the Introduction of Goods Traffic on our Suburban Tramways); (2) "The Quimby Electric Screw Pump," W. T. Bonner, Montreal. "Experiences of an Inspector," Dr. J. K. Johnstone, Inspector of Electric Light, Toronto. "The Electric Current in the Rainy River Gold Mines," W. W. Hopkins, B.Sc., C.E., etc. "The Importance of Proper Methods of Illumination," F. A. Bowman, M.A., B.E., New Glasgow, N.S. "Economics in the Boiler Room," James Milne, Toronto. P. G. Gossler, Montreal, is also expected to read a paper.

SOCIAL FEATURES.

Tuesday, June 28th.—7.30 p.m.—Trip around Mount Royal by special Park and Island cars, afterwards ascending Incline Railway to lookout on mountain to view the city under illumination.

Wednesday, June 29th.—1.00 p.m.—Visit to (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic and Land Company, returning to city at 7.30 p.m. 9.00 p.m.—Annual association banquet at Windsor Hotel.

Thursday, June 30th.—11.00 a.m.—Visit to McGill University. 1.30 p.m.—Visit to Royal Electric Company's lighting station and factory, then by special G.T. train to visit the works of the Chambly Manufacturing Company at Chambly.

FIRES OF THE MONTH.

May 1st—S. Buyant's sawmill in Tecumseth, Ont., together with 50,000 shingles. No insurance.——May 4th—The factory and manager's house of the Truro Condensed Milk and Canning Co., Truro, N.S. Loss $55,000; insurance on stock and buildings $35,000.——May 7th—One of the Canadian Gold Field Co.'s buildings at Deloro, Ont. Damages, $75,000; insurance, $41,000.——May 8th—Premises formerly occupied by Ontario Pump Co., Cecil st., Toronto, destroyed. ——May 10th—J. H. Connor's washing machine factory, Sussex st., Ottawa. Loss about $10,000.——May 17th—McBuril's furniture factory at Moosomin, N.W T. The loss on the furniture factory is $5,000; no insurance.——May 25th—The Thornbury, Ont., woolen mills, completely destroyed; supposed to be incendiary; insured for $5,000.

LITERARY NOTES.

There has just been published the second edition, revised and much enlarged, of "Gas, Gasoline and Oil Engines," by Gardner D Hiscox, M.E. This is a book designed for the general information of every one interested in this new and popular motive power, and its adaptation to the increasing demand for a cheap and easily managed motor requiring no licensed engineer. The book treats of the theory and practice of gas, gasoline and oil engines, as designed and manufactured in the United States. It also contains chapters on horseless vehicles, electric lighting, marine propulsion, etc. The following are the subjects discussed:—History of the system, theory of the gas and gasoline engine, utilization of heat and efficiency in gas engines, heat efficiencies, ratarded combustion and wall-cooling, causes of loss and inefficiency in explosive motors; economy of the gas engine for electric lighting; the material of power in explosive engines, gas, petroleum products and acetylene gas; carburetters, and vapor gas for explosive motors; cylinder capacity of gas and gasoline engines, mufflers on gas engines; governors and valve gear; igniters and exploders, hot tube and electric; cylinder lubrication; management of explosive motors; measurement of power by pony brakes, dynamometers and indicators; measurement of speed, the indicator and its work; vibrations of buildings and floors by the running of explosive motors; explosive engine testing; various types of gas and oil engines, marine and vehicle motors; United States patents on gas, gasoline and oil engines, and their adjuncts—1875 to 1897 inclusive; list of the manufacturers of gas, gasoline and oil engines in the United States, with their addresses.

"The Making of the Canadian West," is the title of a new contribution to Canadian history, by the Rev. R. G. MacBeth, M.A. This is the second appearance of the author before the Canadian reading public, and his pursuit of historical work is amply justified by the warm reception given to his first effort recently published under the title of the "Selkirk Settlers in Real Life." This was a description of the mode of life and surroundings of the early settlers in the region now known as the Province of Manitoba, and the story told by one who lived among them, was so life-like and charming that the reader longed to know more of the leading actors in this interesting drama of colonization. Hence the present book, which gives graphic sketches of the leading men who figured in the political and social life of the Selkirk settlement. To use the words of the author in his preface, he has simply gone back and lived through the past again, seeing the faces and hearing the voices of other days, and what he has seen he has written. The result is a most valuable contribution to Canadian history, and the work is embellished with portraits of some ninety individuals, more or less prominently associated with affairs in the North-West. The author's style is easy and unaffected, and his sketches have a life and force derived from personal experience and observation. The work is dedicated to Lord Strathcona, whose portrait appears as a frontispiece. The publisher is William Briggs, Toronto, a name which is invariably associated with good typography. We warmly commend this excellent book.

"The Pioneers of the Klondyke," which is an account of two years' police service in the Yukon before the country became so well known as it is now, is narrated by M. H. E. Hayne, of the North-West Mounted Police, and written by H. West Taylor. The illustrations, which are numerous, are from photographs taken on the spot by the narrator. The typography is excellent, and the whole volume is worthy of the publishers, Sampson Low, Marston & Co., London, England.

The Engineering Society of the School of Practical Science, Toronto, has issued its annual volume of papers read before the society during the year. Among the contributors are . A. W. Campbell, C.E.; P. H. Bryce, M.A., M.D.; W. M. Minty, B.A.Sc.; L. B. Stewart, D.T.S., and others.

We have before us proofs of a paper read before the Society of Arts, London, England, by Edwin O. Sachs, on "Stage Mechanism," which gives a valuable insight into some of the underlying principles of this most necessary adjunct of the mimic art.

The Rand Agency, Ltd., Johannesburg, S.A.R., has sent us the list of members and associates of the Chemical and Metallurgical Society of South Africa.

Industrial Notes.

Clinton, Ont., will probably buy a steam road roller at an early date.

Ottawa city council has passed plans for main drainage system to cost $414,000.

Berlin, Ont., has passed a by-law to buy the waterworks from the local company.

Craig Street, Montreal, is to be repaved with scoria blocks at a cost of $73,500.

The Gartshore-Thomson Pipe and Foundry Co., Ltd., has increased its capital to $60,000.

Wm. Stokes, Amherstburg, Ont., proposes to establish a cold storage plant in Windsor, Ont.

The Diamond Glass Co., Ltd., is applying for power to increase its capital to $1,000,000.

The Brompton (Que.), Bridge Co. is about to build a new bridge with iron superstructure.

The Bushnell Oil Company is enlarging the Sarnia refinery so as to almost double its capacity.

The House of Industry, Bradford, Ont., will have two wings added this summer, at a cost of $13,000.

A great deal of permanent pavement will be laid in Guelph, Ont., this summer, chiefly cement sidewalks.

The Canadian Brewing Company, Montreal, is installing a new steam plant using the Kingsley water tube boilers.

Peterboro will soon vote on a by-law authorizing the issuing of debentures for the purchase of a steam road roller.

A flood-prevention dyke is proposed by the city engineer of Brantford, Ont., T. Harry Jones, C.E., to cost $47,583.

The Bennett & Wright Co., Ltd., Toronto, is to put in the plumbing and sewage of the House of Industry, Bradford, Ont.

A. N. Bishop, Annapolis, N.S., is enlarging his sawmill, and has bought an engine and boiler from the Goldie and McCulloch Co., Galt, Ontario.

The McEachren Heating and Ventilating Co., Galt, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a Dake engine.

The Western Loan and Trust Co., Montreal, is installing a new heating system in its building, using the Kingsley water tube boiler. David Ogilvy is the architect.

The MacGregor-Gourlay Company, Galt, Ont., has completed the purchase of the London, Ont., Machine Tool Company's business, and will transfer the business to Galt.

J. R. Booth, president of the Ottawa, Arnprior and Parry Sound Railway, has stated that he will not, at present, build a large flour mill at the Chaudiere, as had been reported.

The Consumers' Gas Co., Toronto, is building brick and stone steel skeleton retort house, Parliament st., Toronto. Bond & Smith, Temple Building, Toronto, are the architects.

N. P. Tanguay, Weedon, Que., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a Crocker Turbine complete with gate, draft-tube and gearing for his sawmill at that place.

The Great North Western Telegraph Co. is installing a new heating system in its large building in Montreal, using the Kingsley water tube boiler installed by E. A. Wallberg, Montreal. David Ogilvy is the architect.

Ed. Mohun, C.E., Victoria, B.C., has made an examination of Rossland, B.C., with a view to scientific sewage disposal, and has reported in favor of a sewage farm below the town, with settling tanks to collect the solids.

G. B. Burland, Montreal, has installed a Kingsley water tube steam boiler plant in the Union Card and Paper Co.'s new works. This is the second order that Mr. Burland has given for Kingsley boilers after using them for four years.

It is reported that a European petroleum syndicate, which controls the immense oil wells at Baku, has purchased the property of the Newfoundland Oil Co., situated on the West Coast of Newfoundland. The price paid is said to have been upwards of $400,000.

The work on the large C.P.R. station and office building in Vancouver, B.C., and the C.P.R. Hotel, at Revelstoke, is progressing rapidly. Most of the materials are procured in the West, and the steel structural work is supplied by E. A. Wallberg, Montreal.

John McDougall Ltd., Caledonia Iron Works, Montreal, had a contract for water filtration with the town of Windsor, N.S., which was set aside by the water commissioners upon a vote of the citizens. They brought suit and recovered the full amount for work done.

If Brantford and Kingston do not grant large bonuses to the Dominion Cotton Mills Co. the factories of the company will probably be concentrated at Three Rivers, Que., where electric power can be had from the Shewanegan Falls. About 5,500 hands are now employed

The Frost Wedge-Lock Wire Fence Co , Cleveland, Ohio, intends starting a branch in Canada, and is corresponding with Welland, Ont., to ascertain what inducements the town is prepared to offer. All the company ask is 1,500 to 2,000 square feet floor space and six-horse power.

The Montreal contracting and building firm of A. Lebeau & Co. has assigned with liabilities aggregating some $60,000 in all, some $55,000 of which is due on mortgage. A demand of assignment was made in March, which they contested, but a second demand results in an abandonment of their estate.

The Laurie Engine Co., has recently installed in its works a high pressure compound Corliss Engine and a Kingsley water-tube boiler plant designed for 175 lbs. working pressure. This is considered in every way a model and a highly economical plant. The Kingsley boilers are installed by E. A. Wallberg, Montreal.

F. B. Gaylord, W. Gerhauser, S. T. Miller, F. A. Goodrich and A. O. Cowles, Detroit, U.S., and E. W. Rathbun and F. S. Rathbun Deseronto, Ont., have been incorporated as the Deseronto Iron Company, Limited, to carry on, in all their branches, the operations of mining, milling, reduction and development, with a capital of $990,000.

The General Engineering Co., of Ontario, Limited, has published a neat volume "Smokeless Heat," which describes the mechanism and application of the Improved Jones Underfeed Mechanical Stoker. A large number of these stokers have already been installed in the large power plants in Toronto and the neighborhood with most satisfactory results, it is stated.

A. C. Hutchinson, architect, Montreal, recently had tests made of the new Kingsley water tube boilers in the Ottawa General Hospital These tests gave highly economical results, exceeding the maker's guarantees by 10 per cent This type of boiler was used in nearly all the recent Ottawa work, including the American Bank Note Co.'s Works, the C. Ross Co.'s building, the Russell Theatre, the Sun Life Insurance Building, the Hotel Cecil, the Harmony Hall, and the Grand Opera House. These boilers were installed by E. A. Wallberg, Montreal.

Belleville, Ont., has been negotiating for the removal of the Thames Iron Works from Norwich, Connecticut, to that place, and has on the report of a deputaiton which visited Norwich, unanimously resolved to submit to the electors a by-law granting a bonus of $50,000, a site of ten acres, free water, exemption from taxation for ten years, and to pay the duty on the plant, which will be removed from Norwich. The company, the chief member of which is F. Mitchell, will first erect a rolling mill, and subsequently, if profitable opening be found, a smelting furnace, nail factory, etc.

The Alberta Railway and Coal Co. has lately caused a survey to be made of the lands lying south of Lethbridge, and proposes to put in irrigation ditches. As the country is adapted in every sense for irrigation, this will open up for cultivation an immense tract of land, which at present is only used for grazing, owing to its dryness. Where water has been applied in gardens the growth has been very luxuriant. It is expected that on completion of the system there will be a large influx of settlers from the United States, who understand and appreciate irrigation better than Canadians. The Kootenay market for hay, oats, vegetables, etc., will be quite close to this land.

The old suspension bridge across the Niagara River, connecting the Queen Victoria Park with Niagara Falls, N.Y., has been converted into an arch bridge of the same model as the Grand Trunk's new single-arch bridge. The steel arch was built up from either side of the river directly under the platform of the old bridge, and the work of alteration did not obstruct traffic over the bridge, except for a very short time. Both the arch bridges across the Niagara were designed and built under the supervision of L. J. Buck, C.E., New York. The new bridge is of the same pattern as the one built for the Grand Trunk, but is larger and has a greater span of arch, but is not calculated to sustain such heavy traffic as crosses the railroad company's bridge. The steel arch of the new bridge has a span of 840 feet, and the full length of the bridge is 1,240 feet. The length of the arch in the Grand Trunk bridge is 550 feet, and the length of the bridge, including approaches, is 1,100 feet. The centre of the new bridge is 190 feet above the river. The material of the old suspension bridge is to be used in the construction of a new suspension bridge across the Niagara River from Lewiston to Queenston.

The tenderers for the Port Colborne, Ont., waterworks, in whole or in part, are: St. Lawrence Foundry Co., Toronto; Londonderry Iron Co., Nova Scotia; Adam Hope & Co., Hamilton; Gartshore, Thompson & Co., Hamilton; Hamilton Fire Escape Co., Hamilton; Drummond, McCall & Co., Montreal; Kerr Engine Co., Walkerville, Ont.; Rumsey & Co., Seneca Falls, N.Y.; Northey Mfg. Co., Toronto; Goulds Mfg. Co., Seneca Falls, N.Y.; J. W. Ruger Mfg. Co., Buffalo; Walsh Boiler Works, Springfield, Mass.; R. Brown & Sons, New Glasgow, N.S.; C. Richmond, Humberstone; Hunter Bros., Kincardine, Ont.; Geo. W. Moore. Buffalo; J. G. McKay, Thamesville, Ont.; W. B. Wilson, Buffalo; J. E. Kennedy, Owen Sound, Ont; Clark & Connelly, Toronto; McQuillan, & Co., Toronto; W. W. Reid, Niagara Falls; Craig & Lynch; Hill & Gowanlock, Toronto; Fairbank, Morse & Co. The following are the lowest tenders: For cast iron pipes, hydrants, valves, etc., St. Lawrence Foundry Co., Toronto, $7,255 50; for complete system, Clark & Connelly, Toronto, $17,800; McQuillan & Co., Toronto, $18,960; Hill & Gowanlock, $16,899. Lowest figures, taking separate bids for completed work, $16,503 78. Pumping station was W. B. Wilson, Buffalo, $900. For stand-pipe, Walsh Boiler Works, Springfield, Mass., $995.

Mining Matters.

During one fortnight recently over forty miners left Johannesburg for the Klondyke.

The discovery of rich gold-bearing deposits is reported from Lake Clare, twenty-one miles north of Ste. Anne de Chicoutimi, Que.

The Jenckes Machine Co., Sherbrooke, Que., shipped on the 5th inst. a complete 10-stamp mill to the Cariboo Mining, Milling and Smelting Co., Fairview, B.C.

The Jenckes Machine Co., Sherbrooke, has equipped the Athabasca Mine, Nelson, B.C., with complete hoisting outfit and boiler. This mine is sure to become a producer of prominence.

D. S. McArthur & Co., Nelson, B.C., are developing their properties, and recently purchased, through the Rossland branch, from the Jenckes Machine Co. a complete hoisting plant.

The Monte Cristo Mine continues sinking in the main pit, and has lately added a No. 6 Cameron vertical pump, purchased through the Rossland branch, from the Jenckes Machine Co., Sherbrooke, Que.

The Rat Portage Diamond Drill Company has shipped machinery to Shoal Lake, where work has been commenced on the Cornucopia property.

Rossland, B.C., has organized a mining school by means of local subscriptions. About sixty students began the study of geology there early in April.

Mining in Newfoundland is likely to become more active very soon. The agents of at least five wealthy companies are at present in the Island examining properties, chiefly copper, with a view to purchase.

The Dundee Mining Company, Rossland, B.C., has just let a contract for furnishing material for a three-line gravity tramway. The price is $1,400. The company will erect trestles and install the tramway.

The Bonanza Nickel Mining Company at Wahnapitae, Ont., has erected a ten-stamp mill at the Mammoth gold mine, which is now in operation under the management of Henry Dierlamm, formerly of Chesley, Ont.

W. M. Slack, Petrolea, Ont., Fred. Beresford, London, and John MacRae, Petrolea, are on their way to Edmonton, N.W.T., to test an oil well for the Dominion Government. They expect to drill 2,200 feet before they strike oil.

George Wilson, contractor, Kingston, Ont., has bought a large mica mine situated two miles back of Gananoque, Ont. The mine was opened some time ago, and $2,500 spent on it. Samples of the mineral show it to be of a superior quality.

The London and British Columbia Gold Fields Co., Ltd., Rossland, B.C., is developing its property, and recently added to its equipment a 6 x 8 special hoisting engine and 40 h.p. locomotive-type boiler from the Jenckes Machine Co., Sherbrooke, Que.

Prof. Frank D. Adams, professor of geology and paleontiology in McGill University, has declined, out of regard to the wish of the university, the position of Provincial Mineralogist of British Columbia, the position until recently held by Prof. Carlyle.

The Coleraine Mining Company is reorganized, and the new directorate has employed A. Davis, their consulting engineer, to put in a complete new plant for mining at Black Lake, Megantic, Que. The company has orders for the entire output for three years.

The Jenckes Machine Co., Sherbrooke, Que., recently supplied the Sydney mine at North Sydney, Cape Breton, with a special coal hoisting engine, to be operated by compressed air. The compressor was supplied by the Canadian Rand Drill Co., Sherbooke, Que.

Geo. M. Webster & Co., Quebec, coal handlers, are improving their facilities for unloading steamers, and for this purpose have placed an order with the Jenckes Machine Co., Sherbrooke, Que., for four of their double cylinder rapid coal-hoisting engines with boilers.

The Dominion Coal Co. is improving the facilities for unloading from its steamers at Levis, and has purchased for this purpose four 8¼ x 10 double cylinder special coal hoisting engines from the Jenckes Machine Co., Sherbrooke, Que., with a powerful 100 h.p. locomotive boiler.

The British American Corporation, Rossland, B.C., is pushing the development of its properties, and the Jenckes Machine Co., Sherbrooke, through its Rossland branch, has supplied it with special pumping apparatus for the Nickel Plate, and Columbia and Kootenay mines.

Manganese iron ore is freely imported into the United States from various countries in Europe and South America. Extensive deposits of this ore exist in New Brunswick and Nova Scotia, and it would appear that Canada is losing a profitable trade which is lying right at her doors.

The Smuggler Gold Mining Co., headquarters Toronto, has decided to put a 20-stamp mill on its property at Fairview, B.C., this summer, and an order has been placed with the Jenckes Machine Co., Sherbrooke, Que., for Corliss engine, boiler, 20 stamps, vanners and four miles of aerial tramway.

The Bell Asbestos Co., Thetford Mines, Que., is changing over the system of operating the mine hoist, and for this purpose has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a 100-h.p. steel tubular boiler, and have also purchased from the same company a small locomotive for shifting cars in pits.

The Canadian Copper Co., of Copper Cliff, Ont., is fitting a new shaft, has placed an order with the Jenckes Machine Co., Sherbrooke, for two 100-h.p. special steel boilers, one 12 x 15 double cylinder double drum winding engine, three large steam pumps and rock breaker, and necessary gear for operating them.

The annual meeting of the Newfoundland Oil Company was held recently, the majority of the shareholders being present, and President Thompson occupying the chair. The report of the Secretary-Treasurer which was presented and adopted was of a most satisfactory nature. The officers of last year were re-elected.

Supplementary letters patent have been issued by the Quebec Government granting the Combustible Gas Company an exclusive privilege of working and making use of the combustible gas which exhales in various parts of the province, for the purpose of lighting, heating, and supplying motive power until August 30th, 1901, inclusive.

E. T. Wilkie, C.E., Carleton Place, Ont., and Andrew Bell, C.E., Almonte, Ont., are in charge of the survey now being made for a tramway to connect the iron mines now operated by the Hamilton smelting works, in Darling township, Lanark county, Ontario, with the Kingston and Pembroke Railway at Flower Station. The line may be ultimately an electric railway.

A Rossland, B.C., report states that the recent strike on the Jumbo is a good one. The body of ore was struck in the lower tunnel, and the whole force of the working is said to be in rock assaying $113 to the ton. The tunnel referred to was started in August, 1896, and has now been run in 800 feet in the ledge. It is 200 feet below the ore body discovered two years ago, and gives a "back" of 350 feet.

Vancouver, May 5.—The city council has, subject to the ratifying vote of the taxpayers of Vancouver, agreed to pass a by-law granting to the Van Anda Gold and Copper Mining Company a subsidy of 40 cents a ton on ores smelted by it at a smelter to be built and operated at some point within five miles of the limits of Vancouver, the total subsidy payable to be limited to an aggregate of 125,000 tons, making $50,000 in all.

The Vancouver, B.C., city council has accepted the offer made by the Anglo Continental Public Works Company of London, Eng., and that city is to have a smelter. The proposition in brief was as follows: It is stipulated that the city shall give the company a bonus of 50 cents per ton on ore treated, not exceeding 30,000 tons in any one year, in return for which the company shall give the city £50,000 in preference 10 per cent. shares.

At Belle Island, in Conception Bay, Newfoundland, the Nova Scotia Steel Co. have developed extensive iron deposits. The company is the lessee of four grants of land, each of one square mile, and during the past few years have erected an extensive and costly plant for the mining and handling of the ore. The bulk of the ore has been shipped to New Glasgow, where it is mixed with Nova Scotia iron and produced pig iron. The company employs an average of 200 men, and the deposits are estimated to contain some 40,000,000 tons of ore and the assays give from 48 to 56 per cent. of metallic iron.

The directors of the War Eagle Consolidated Gold Mining Company have decided to begin paying monthly dividends of 1½ per cent. The first dividend is payable on 1st June. The company is capitalized at $2,000,000, in one-dollar shares, of which 350,000 still remain in the treasury. The June dividend upon the 1,650,000 shares in the hands of stockholders will total $24,750. The mine ships to the C.P.R. smelter at Trail 100 tons per day, or 3,000 tons per month. The smelter people buy the ore as it arrives, upon its assay value, the War Eagle netting about $17.50.

The Canadian Pacific evidently intends to supplement its network of railways in the Kootenay by a system of smelters. Having bought the Heinze smelter at Trail, B.C., the C.P.R. is now adding to its plant two new blasts, which will bring the daily capacity up to 500 tons It is also stated that the railway company will erect a lead smelter at Trail, the plant to be in operation before the first of next year. This lead stack will adjoin the property acquired from Heinze, and will have a capacity of 150 tons a day, the idea being to treat the Slocan and Ainsworth galena ores in conjunction with the pyrrhotite ores of Rossland camp.

At the annual meeting of the Toronto Smelting Company, Limited, which was held in Canada Life Building, Toronto, recently. James Kendry, M.P., was elected president; J. D. Hay, Toronto, vice-president; W. A. Hungerford, Belleville, general manager; F. C. Flannery, secretary-treasurer, The company proposes to establish smelting works at Madoc, if satisfactory arrangements can be made; if not, they will establish works at Duoro or Marmora. The company has already made tests at Millbridge, and the results have been so satisfactory that it has decided to erect a custom and testing smelter. The company intend to pay special attention to arsenic, as the mispickel ores of this region are especially noted for the production of arsenic.

The Ontario Bureau of Mines has received news confirming the reported discovery of placer gold near Sudbury. The finds are said to be on the Vermillion River, to the north of Sudbury, probably at the head waters of the river, near the Height of Land, west of Lake Wahnapitae. The Department has received numerous applications for mining location in this district recently, but none has been granted, as this part of the country has been withdrawn from sale on account of its valuable timber, which has not yet been disposed of by the Government. Some prospectors who have come out state that the gravel is abundant, but the pay is not high, and that only on a large scale would the diggings pay to work. Others say that three to five dollars a day can be easily taken out.

The Crow's Nest Pass Coal Company, Fernie, B.C., expects to be able to supply the smelters in Montana, Idaho, Northport, Trail and Nelson, which are at present using the Welsh coke, which costs them from $16 fo $18 per ton. The Crow's Nest Co. hopes that it will be able to furnish better coke to the two Canadian plants for $7 per ton. It will, of course, be higher delivered in the United Sates. The Crow's Nest coke is said to contain 95 per cent. fixed carbon and only 4 per cent ash. . It is estimated that by this reduction in the price of fuel the smelters will be able to save $1.50 per ton in the cost of treating ore. The present consumption of coke at the smelters which the company hopes to supply is as follows: Northport, 40 tons per day; Trail, 60 tons; Hall Mines, 40 tons; Everet, 60 tons; Tacoma, 40 tons; Great Falls, 150 tons; Helena, 50 tons; Butte and Anaconda, 400 tons. It will at the outset be called upon to furnish 840 tons a day.

A letter from Rossland under date May 11th gives some items of interest respecting what is doing in the Kootenay mining district. Development is active, and the hopes of both prospectors and miners appear to be high. The War Eagle mine proprietors have been negotiating with the General Electric Company about a compressor plant and elevator, and have at last closed a contract for the same. The Boundary Creek country is progressing up well, and a ten-drill compressor plant, with hoisting-engine, heaters and pumps, is under contract from the Cooper Company, of Montreal, to be furnished to the British Columbia Copper Company, of Anaconda. At the Le Ro smelter they are said to be running 250 to 300 tons of ore per day, principally from the Le Roi mine. At the Hall mines smelter, at Nelson, by their published report, the output for twenty days up to 30th April was 218 tons of matte from 4,734 tons of ore, where in 31 days ended 2nd April, they had turned out 357 tons matte from 7,437 tons of ore treated. The new superintendent of the smelter, R. R. Hedley, is proving his ability and has, it appears, done more successful work than either of his predecessors, even although he is a Canadian, born and educated outside of "Europe." The people here, or perhaps I should say some of the people here, did not like what Mr. Hedley said, in 1896, about the character of the Rossland ores, but he is proving to be about right in his estimates of what can and cannot be done with it. Other experts were planning and working on a basis of 60 and 65 per cent. copper matte. But the matte does not pan out anything of the sort. In fact the Hall Mines people are at present producing only a 45 per cent. copper matte, which is a very different story. It will give you an idea of the extent of the activities in this part of Kootenay, the writer says, if I tell you that, as I learned from the custom authorities, there was raised and shipped through the Nelson custom house 31,920 tons of ore, valued at $3,116,212 during the period from 1st January to 30th April, 1898. The banks are finding that it is worth while to look after business here, and I am told that the Bank of Montreal will very shortly erect a handsome three-story building in Rossland for banking premises and other purposes.

Marine News.

The Yarmouth Steamship Co.'s new steamer "Express" has been fitted up at Liverpool. She will carry 200 passengers and will arrive at Yarmouth early in June.

The Bertram Engine Works Co. have secured the contract to build a steel grain-carrying propeller to be used in place of the Rosedale. The new vessel is to be 255 feet long by 43 feet beam.

The Lake Champlain and St. Lawrence Ship Canal Company charter has been granted by the Dominion Government, but it is not to become operative without the consent of the Governor-General-in-Council.

L. Lacouture, Sorel; J. O. Blondin, La Baie des Peres; D. Gillies, M.P.P., Carleton Place, Ont.; J. Gillies and J. Gillies, Breaside, Ont., have been incorporated as the Lac Temiscamingue Navigation Company, Ltd., capital $25,000.

The port of St. John, N.B., did a much larger business during last winter than the one previous. Last winter there were 53 steamers sailed as against 46 the winter before, and there were 3,639,000 bushels of grain trans-shipped as against 1,436,000 bushels in 1896-97.

Capt. Macauley, of the Dominion liner "Canada," has been appointed to the command of the company's new steamer "New England." His successor will be Capt. Maddox, of the "Scotsman." The latter will be commanded by the second officer, Capt. Skrimpshire.

The large freighter built at Leigh's shipyard, Victoria, B.C., for Capt. W. Grant, was launched a short time ago. The steamer is 107 feet in length with 24 feet beam and 7 feet deep. She will have a speed of eight knots and will enter the freighting business. Spratt & Gray are fitting her with machinery, and Shaw's Iron Works will supply her boiler.

Murray & Munroe, Pembroke, Ont., have completed the new wharf at L'Orignal, Ont.

The Richelieu & Ontario Navigation Company has declared a semi-annual dividend of 3 per cent.

The C.P.R. is arranging for the construction of a $6,000 dock at Kaslo, B.C., similar to the one at Nelson.

The steamers "New York" and "Empire State" will supply a daily service down the St. Lawrence rapids this summer, running from Clayton to Montreal. The Folgers of Kingston are the proprietors of the line.

A. J. Harvey & Co., St. John's, Newfoundland, have bought the steamer "Lucerne" from the Allans, to carry pulp and general freight from Newfoundland to England. Capt. D. Taylor has been appointed to the command.

James Playfair & Company's tug, the "Magnolia," was launched at Midland, May 24th. She is 140 feet long, 21 feet 6 inches beam, and will draw, coaled, fourteen feet of water. She will be used principally for towing and wrecking.

The earth under the River St. siding and the coal docks, Owen Sound, slid into the river recently, allowing both to sink about five feet for a distance of over two hundred feet. Dredging the harbor is supposed to be responsible for the slide.

The Furness line will formally take over the business of the Canada and Newfoundland Steamship Co., which it has bought, on July 1st. The four men who owned these boats were: David McPherson, W. Barry, P. Pierson, and S. M. Brookfield.

Two new passenger steamers of the Dominion Line will be on the St. Lawrence route from Montreal this season, viz., the "Dominion," a fine twin screw steel ship of 6,000 tons, equal to the "Canada" in finish, and the "Yorkshire," also new and of similar construction and equipment.

Captain Thomas Howard, the late harbor master of Montreal, who died recently, was well known and much respected in commercial circles in Montreal, where he had been a resident fifty-six years. He was born at Shinrone, Queen's County, Ireland, on Sept. 15th, 1826, and came to Canada in 1842. For a time after his arrival he was in the employ of the late Hon. John Hamilton, and later entered the service of the Richelieu & Ontario Navigation Company. For some years he commanded the "Banshee," "St. Lawrence," "Magnet" and other vessels of the company plying between Montreal, western ports and the Saguenay, and was subsequently appointed manager of the Ontario division of the company. In March, 1881, he was appointed harbor master. He had thus been connected with the business of the port for nearly half a century.

A large deputation from Kingston, Prescott and Deseronto, waited upon the Minister of Marine and Fisheries recently, to request that the department should make an order suspending the regulations for this year, which require American passenger steamers to comply with the same regulations as Canadian passenger steamers. The Canadian inspection requirements are not the same as American, differing particularly with respect to life preservers and the inspection of boilers. It has been the custom in the past to accept the American inspection, but an amendment to the Canadian Act requires conformity to the Canadian regulations. The deputation comprised delegates from Kingston and other towns and was accompanied by the following members of parliament: Messrs. Britton, Charlton, McGregor, Frost, Hurley, Edwards and Snetsinger. The Minister promised to give the request a favorable consideration if possible.

The Manchester Liners, Limited, is formed to acquire and run three steamers between Manchester and Montreal in summer, and St. John, N.B., in winter. These steamers are to cost £90,000 each, are to steam twelve knots an hour, and to have a carrying capacity of 8,500 tons. One is to be ready in August and two in the spring of next year. But two steamers are to be immediately acquired for the work, so that the approaching autumn and winter will now be amply provided for. There is no question of the extent of the traffic available, and we share the confidence of the directors that the new service will have remunerative results. The authorized capital is £1,000,000 in shares of £10. Sir Christopher Furness is chairman of the company, and his experience is security that the company's business will be conducted with intelligence as well as vigor.

The Pembroke Navigation Company has launched the new vessel recently built for them in Toronto by the Polson Company. She is built of iron and is 125 feet in length, with a twenty five foot beam, and is capable of attaining eighteen miles an hour. The cost was $30,000.

The Donnelly Wrecking Company of Kingston have purchased the sidewheel steamer "Columbia," which ran ashore at Sarnia last summer. She will be put on the government dry dock at Kingston. The "Columbia" was formerly worth $10,000.

Mr. O. E. Young, of Magog, is building a small pleasure boat for Mr. L. B. Ward, of Brooklyn, N.Y., to be used on Lake Memphremagog, and an order has been placed with the Jenckes Machine Co., of Sherbrooke, Que., for one of their 7 h.p. Dake marine engines, with boiler to run the same.

The two steamers for the Dominion Atlantic Railway Company, being built on the Humber, England, are the "Prince George," which will reach this country about the middle of June, and the "Prince Arthur," which will come a fortnight later. Both steamers are alike. They are 300 feet long, 38 feet beam, 15 feet draught and 6,500 h.p. They have a speed of 21½ knots on the measured mile and are guaranteed 19½ knots at sea in any weather. Each engine has four sets of cranks instead of the usual three. All the heating will be done by electricity and they will have electric fans.

An announcement of some commercial interest to Canada is to the effect that the enlargement work on the Erie canal will have to be suspended for at least two years. Through some miscalculation or mismanagement the nine millions voted for the work has been expended, and the waterway is available for no larger craft than have navigated it for years past. It will take two years, under the law, it seems, to obtain authorization for a further loan, and some time more to complete the enlargement operations. Meantime, if the present programme is carried out, next season will see the enlarged St. Lawrence canals available, and Canada will have at least a year's start of New York in the use of the improved waterways.

The Polson Iron Works, Toronto, have just shipped a steamer, which will be the first to reach the Yukon, intact from this port. The boat started from here to Vancouver on two C.P.R. flat cars, whence it will be forwarded on an ocean steamer to the Yukon—an exploration boat, built for either day or night service, and to accommodate four mining engineers and crew. She is called the "Burpee," after her purchaser, and is, length on water-line 45 feet, over all 53 feet, beam 9 feet, draught of water 10 inches. She was designed by W. E. Redway, is built with a steel frame and wood planking, with boiler and engine aboard ready for immediate service on reaching her destination. Her speed will be about 10 to 12 miles; cost, $6,000.

Railway Matters.

The C.P.R. will build a new station at Almonte, Ont., this year, it is expected.

The management of the G.T.R has decided to construct 250 refrigerator cars for the general service of the system.

There are at present 200 men at work in the Perth, Ont., car shops of the C.P.R., and work is continued each night up till midnight.

Dutton, Ont., has defeated the by-law granting a bonus to the L.E. & D.R.R. in aid of the extension from Ridgetown to St. Thomas.

The bill of the Ottawa, Montreal and James Bay Railway Co., was passed by the Dominion Government recently. The intention is to build north from Labelle, about 100 miles north of Montreal, and to continue to the shores of Rupert's Bay, a distance of 375 miles.

It is stated that Louis Coste, chief engineer of the Dominion Public Works Department, has pronounced against the Mackenzie-Mann Teslin Lake Railway scheme, and that it was on account of this hostile report of the government's own engineer that Sir Wilfrid Laurier telegraphed to British Columbia that the ministry could not support the scheme.

The Ottawa and New York Railway Co. has offered to build its workshops in Ottawa if it is given a bonus of $100,000.

The case of Hannaford v. Grand Trunk is postponed for some time, because it has been decided to appoint a commission rogatoire to take the evidence of Sir Charles Rivers-Wilson and Messrs. L. J. Sargeant and Linley, the commission being returnable on June 18th. Charles Russell, son of the Lord Chief Justice, will act as the commissioner.

The city of Montreal has offered a free site for an office building for the G.T.R., and the Grand Trunk has accepted the gift. This finally disposes of Toronto's fancied prospect of securing the office. The terms upon which the site will be given, are as follows: That the company be offered part of the McGill street property, owned by the city, as follows: 199.4 feet on McGill street, and 135 feet on St. Paul and William streets, respectively; the building to cost not less than $250,000, the assessment to be levied on that amount only for a period of twenty years, this latter arrangement to be submitted to the legislature for ratification. The plans of the proposed building to be submitted to the city for approval.

Sixteen "Mogul" engines have been purchased by the C.A. & O.A. & P.S. Railways for the freight business. The engines are much larger than the ordinary passenger locomotives. Compared with the new engines the old ones look quite small. Ten of these new engines are of the ten-wheel "Mogul" type and each weighs 156,000 pounds without the tenders. They have three couple-wheel drivers and are equipped with compound cylinders. The other six engines are of what is known as the consolidated type of "Mogul." They are equipped with four couple-wheel drivers, and have compound cylinders. They weigh 173,000 pounds exclusive of tenders. The engines will be used exclusively for freight.

It would seem that the C.P.R. has definitely decided to push forward a line from Toronto to Sudbury at once. Two corps of surveyors are already at work in charge of H. D. Lumsden, who surveyed the Crow's Nest Pass road. One party will spend the entire summer in the Nipissing district, and another party will start out from Coldwater and survey southward through Barrie to the Orangeville branch of the G.T.R. at Kleinburg or Bolton. The new line will take the shortest cut between Parry Sound and Sudbury, and will extend inland so as to open up the Nipissing and Parry Sound districts. From Parry Sound the road will extend southwards to the west of Muskoka lakes, and across the Muskoka river at Bala, thence to Muskoka wharf and south-west across the Severn river to tap the Midland branch of the G.T.R. at Coldwater. The new line will save 55 miles haulage between Toronto and Winnipeg, and will be completed in about two years.

The British Columbia Government has passed a railway aid bill, which provides $4,000 per mile for the following railways: From Penticton to Boundary Creek, 100 miles; from Robson to Boundary Creek, 80 miles; from the Pacific coast to Penticton, 230 miles; from Bute Inlet to Quesnell, 230 miles ; from Teslin Lake to a British Columbia seaport, not exceeding 400 miles. The act provides for the commencement of the Penticton-Boundary and Robson-Boundary lines on or before the 8th of August, 1898, and on the coast to Penticton and Bute Inlet to Quesnelle on or before the 8th day of May, 1898, work to commence on the Yukon line on or before the 8th day of June, 1898. The bill further stipulates in the case of the line from Robson to Boundary being built by a company entitled to a land grant, that such company shall relinquish its claim to the land grant for such portion of its line on accepting cash subsidy. It was expected that McKenzie & Mann would build this line but they have notified the British Columbia Government that they cannot carry out the work.

Bystander, in the St. John's, Que., News, commenting on the Hannaford v. G.T.R. case, and contrasting the old regime of that railway with the new, says: "Mr. Hays is down at his work at nine o'clock in the morning. He generally walks to the Point, but, if in a great hurry, he will permit himself the luxury of a street car. This may seem a trifle in a man who can think as clearly at ten as at nine o'clock, but it has worked a revolution in the Grand Trunk system. Punctuality is understood for the first time in the history of the company. Duty means enthusiastic and earnest and unflagging work. Nepotism has been taken by the shoulders and bundled out of the thought of the new management. The sole test is merit. The humblest person has as much chance of preferment as the nephew of the president. Mr. Hays is a direct, simple, democratic personality, and every officer under him is accessible to the public at all times. The new manager would be vastly surprised to see one of his officials coming down to his office in his carriage at eleven o'clock in the day, as was the case under the old regime.

Electric Flashes.

Belleville, Ont., Street Railway is to be extended to a park on the lake shore.

Free power is obtained from the Canada Coal and Railway Company to run the electric light plant at Joggins, N.S.

Bonuses are being sought for the proposed electric road from London, through Stratford, Arkona and Thedford, connecting the Canadian Pacific with the Grand Trunk.

S. H. Kent, secretary of the Hamilton, Ont., Committee on Municipal Lighting, is carrying on an extensive correspondence in pursuit of information regarding civic electric lighting in other municipalities.

Simeon H. White, Andrew L. Price, C. Geo. Armstrong, Walter J. Mills and Hamilton B. Price, Sussex, N.B., have applied for a New Brunswick charter as The Little Salmon River Telephone Company, Limited, capital $1,500.

The by-law authorizing the agreement with the Montreal Street Railway Company was voted on at Verdun recently, when eighty-three proprietors voted in an approval of an immediate street railway service, and only six voted contrary. The by-law was therefore affirmed.

At the annual meeting of the Quebec Electric Street Railway Company, Andrew Thomson was elected president; E. W. Methot, vice-president; and W. Shaw, Jno. Breakey, Judge Chauveau, E. E. Webb and Harold Kennedy, directors for the current year.

A company from Bellechasse has asked for Quebec letters patent under the name of the Ste. Philomene Telephone Company. It will place telephones in the counties of Bellechasse, Montmagny and Dorchester, with headquarters at St. Raphael, and a capital of $1,500.

The Toronto City Council is engaged in a dispute with the Electric Light Company, the result of an effort on the city's part to compel the company to light the Island, which is within the city limit, at the city rate of 20¼ cents per lamp per night.

The contract for covering the pipes and boilers in the power house of the St. John Railway Co., St. John, N.B., has been completed by the Eureka Mineral Wool and Asbestos Co., Toronto. This company has had several large covering contracts of late, not a few of which were repeat orders.

The Niagara Falls, Ont., Electric Light Company has purchased machinery from the Westinghouse Company, to provide electricity for heating and power purposes, in addition to the present lighting system. The changes that will be made at their power house, and wiring of streets, etc., will involve an expenditure of about $10,000. They will be able to supply from one to seventy-five horse-power 24 hour service.

The plant of the Acetylene Light, Heat and Power Company, known as the Carbide works, at Niagara Falls, N.Y., was sold under chattel mortgage proceedings a short time ago. The action was brought by the Electro Gas Company, of New York, who held the mortgages, and the plant, machinery and power rights were bought by them for about $85,000. The Electro Gas Company will continue the business.

The Kingston Street Railway has about completed a branch line to the outer G.T.R. station on Montreal Street, going by way of Bagot and Montreal streets. It will be in operation early this month. The line will be in competition with the Grand Trunk Railway, which has reduced fares to five cents per trip. It is expected that much of Princess Street will be double-tracked and a belt line made on the northerly side of the city by way of Division, Pine and Montreal streets.

A dynamo and a number of lamps have been supplied by the Royal Electric Company to the Soulanges Canal.

Wood Bros., Brantford, Ont., have recently bought from the Royal Electric Company a 70 h.p. synchronous motor.

The Montmorency Power Company, Quebec, has bought a 600 K.W. "S.K.C." generator from the Royal Electric Company.

C. E. Campbell, Weymouth, N.S., has been supplied with a direct-connected lighting plant by the Royal Electric Company.

A 300 K.W. "S.K.C." synchronous motor has been bought from the Royal Electric Company by the Golden Cache Mining Co., B.C.

The contract for building the Canadian branch of the Carborundum Works, Niagara Falls, Ont., has been secured by James Harrison. The structure will be frame 30 x 60 feet.

The B. C. Bullion Extracting Co. has made a contract with the Canadian General Electric Co. to supply a 100 horse-power synchronising motor, and a 50 horse-power induction motor for their works, which are about a mile and a half from Rossland, B.C.

John Forman, importer of electrical supplies, 644 Craig street, Montreal, has recently issued catalogue "B," which contains a great deal of useful information for all users of electrical apparatus of any kind. Edison lamp, Ericsson telephones, Anchor switches, and a great many other standard appliances, as well as numerous novelties, are always carried in stock.

J. R. Scott, an enterprising citizen of Napanee, has closed a contract with the Canadian General Electric Co. for a 100 K.W., 4,000-volt three-phase generator of the revolving field type, for the purpose of supplying light and power to Napanee from a water-power eight miles distant. He will also supply light and power to intermediate points such as Napanee Mills, Camden East, and Newburgh.

A meeting was held at the Halifax Hotel, Halifax, N.S., April 12th, 1898, at 3 p.m., for the purpose of organizing an association of all those interested in the electrical industries in the Maritime Provinces. The following gentlemen were present: John Starr, C. E. Harris, Jas. Waddell, N. L. Ross, J. H. Winfield, L. A. Somers, J. D. Briggs, P. Mosher, A. Miller, John Griffin, J. A. Anderson, P. R. Colpitt, F. A. Bowman, E. T. Freeman, I. H. Smith.

The West Kootenay Power and Light Co. is rapidly completing its power plant at Bennington Falls. The poles are set and two wires are stretched between the falls and Rossland, a distance of 31 miles. The line goes into Rossland over the Monte Cristo Mountain, and it is the intention of the company to stretch another wire so that in case of accident there will be no interruption of the current. The first cost of the plant is placed at $125,000, but it is said that the expenditure upon it may be extended to half a million.

A Dominion charter has been granted to the North Shore Electric Railway Company, the applicants being: Wm. Owens, Westmount; V. W. Larue, Quebec; Wm. Strachan, R. Prefontaine, Thos. Gauthier, and Albert J. Corriveau, Montreal. Mr. Corriveau says that it is intended to use power generator at the Shawenegan Falls. The railway is to start at Three Rivers, and general powers are given for the counties on the north shore of the St. Lawrence. Privileges are conferred similar to those granted to Montreal and Southern Counties Railway Company.

E. A. C. Pew's project to produce water power by the construction of a channel from the river Welland, east of Wellandport, to the river Jordan, although remaining in abeyance for some time past is coming to the front again. The works will be gone on with if satisfactory contracts can be made for disposing of the power when generated. Wm. Pearson, C.E., Oswego, has, it is said, pronounced the scheme a feasible, safe and practical one, pointing out that the great source of expenditure in connection with the development of power at Niagara Falls—the construction of wheel pits and tail race—will not be necessary in this project. The principal expense will be the excavation.

Barrie, Ont., is advertising for tenders on an electrical installation to consist of a street lighting plant of 65 arc lamps of 2,000 candle power, an alternating current plant to supply 2,500 incandescent lamps for private lighting, and a direct current 500-volt power plant to furnish cheap electrical motive power to manufacturing establishments. An up-to-date electrical fire alarm system will also be installed. The estimated cost of the entire equipment is placed at $35,000, and as quality of machinery and apparatus will be made a first consideration before prices, the town will, no doubt, obtain a very complete and high-class installation. Tenders will be opened on June 6th next, but the awards will not be made before the ratepayers have voted the necessary moneys. Roderick J. Parke, of Montreal, is the consulting engineer for Barrie.

The C.P.R. copper telegraph line, from Montreal to Vancouver, is now building. The line passes via Vaudreuil and the Short Line to Ottawa, and thence by the main line to the coast. It will be strung under the general superintendency of W. J. Camp, the C.P.R. electrician, in three divisions. The first one will reach from Montreal to Fort William, and will be conducted by Jos. Townsley, with about 100 men, working simultaneously in four gangs. The next division will reach from Fort William to Donald, B.C., and will be under B. S. Jenkins, Supt. of Telegraph, Winnipeg, with three gangs of men. The final division will reach from Donald to the coast, and will be under the charge of J. Wilson, Supt. Telegraph. A great deal of trouble has been experienced by telegraphic companies, through wires coming in contact with each other, through the breaking of the glass insulators by which the wires are attached to the poles. A test was therefore made at McGill University with a view to ascertaining the comparative resistancy of glass and porcelain insulators, with the result that it was found that porcelain resisted much heavier, and a greater number of blows, than the glass. Tests were also made with a thirty-two calibre revolver from a distance of eight feet. The glass flew to pieces at nearly every shot, while the porcelain frequently showed no mark, save the lead from the bullet, and when they did break it was in such a way that, had they been attached to the pole, the wires would not have been affected. The testing of the wire is also going on at the Applied Science Department of McGill, under the care of Mr. Drinkwater. Each day he selects at random a sample of wire from each lot of ten bundles being turned out by the Dominion Wire Mfg. Co., and subjects them to tests in order to insure that they come up to the requirements of the contract. The wire must be .137 of an inch in diameter; one one-thousandth of an inch only of a variation being allowed above or below this gauge. It must be perfectly cylindrical and weigh 300 pounds to the mile; four pounds of a variation being allowed in this distance. Frequent electrical tests are made upon pieces one one-hundredth of a mile in length, to determine the purity of copper used, which must be 97 per cent. Each bundle weighs 170 pounds, and the wire must be in one continuous length, without joint or break. Each six inches of wire must be capable of being twisted thirty times at a uniform speed of one twist a second. The tests show that it will stand forty to fifty twists before breaking. It must stand six close turns around another wire of equal diameter and be unwound without breaking. It must also stand an average breaking strain of 975 pounds, and before breaking it must have stretched at least one per cent. When completed there will be a length of about 2,900 miles of wire.

Personal.

H. M. Bolger, secretary of the Richelieu and Ontario Navigation Co., Montreal, was married a short time ago to Miss Mills, of Quebec.

P. Kennedy, employed in the C.P.R. car shops, Perth, Ont., had his head crushed between two cars, and was instantly killed, May 13th.

R. G. McConnell, of the Dominion Geological Survey, and J. B. Tyrell have left for the Yukon, and will spend the entire season in that district.

H. C. Landon, C.E., Cornwall, Ont., has removed to Austen, Pa., where he will have charge of a section of the Buffalo and Susquehana Railroad.

Frederic Nicholls, managing director of the Canadian General Electric Co., sailed on the "Campana" recently for a visit to England and the continent.

Alexander Milloy, after fifty years of service in the Richelieu and Ontario Navigation Company, acting as traffic manager, has retired. G. A. Browne will be his successor.

Wallace Bell, the well-known well sinker, Montreal, has gone to Newfoundland, where he has been asked to help in developing the newly discovered oil regions in the island.

D. J. McDonald, British Columbia inspector of mines, has resigned his position to enter the service of the British America Corporation, under W. A. Carlyle, late provincial mineralogist.

Wm. Bunney, who has been for the past six years in the employ of the Wm. Cane & Sons Mfg. Co., Newmarket, Ont., as foreman, has taken a situation with W. C. Edwards & Co., Ottawa.

Samuel Lyons, head engineer of the Stewiacke, N.S., foundry, was instantly killed a short time ago. He was working at the emery wheel, when it suddenly broke, a portion of it striking him violently over the heart.

O. H. Sheppard has accepted the position of cashier of the Toronto Ferry Company, made vacant by the resignation of Walter Garwood, who has been appointed to a more lucrative position with the Queen City Oil Company, Toronto.

Mr. D.A. Starr, president and manager of the Cornwall Electric Street Railway Co., was waited upon by a deputation of the employees and presented with a handsome gold headed cane, with many good wishes, on the occasion of his birthday a short time ago.

News reached Montreal last month from Liverpool, of the drowning of a well known Canadian Pacific official, T. F. B. Evans, who was agent at Liverpool for the company for the past ten years. Mr. Evans while boating off Bangor, Wales, where he was enjoying a short holiday, fell out of his boat and was drowned.

W. J. Carroll, St. Catharines, Ont., who has been engaged in engineering work upon the Crow's Nest Pass Railway since last September, has received an appointment as chief engineer of the Sindicate Industriel de Sud America, a company formed to build a railroad from Quito to Pailon, on the west coast of South America. The district about Pailon is famous for its rich gold deposits. The company receives from the Government a concession of about seventeen million acres of land.

W. Robert, cashier of the Richelieu and Ontario Navigation Company, received a handsome present and illuminated address a short time ago. The presentation was made by C. F. Gildersleeve, the general manager, representing the staff of officials, and the occasion was the severance of the connections between Mr. Robert and the company. Mr. Robert will shortly leave for Quebec, to fill the position of paying teller in the new branch of the Hochelaga Bank, about to be opened in that city.

Robert N. Stevens, mechanical superintendent of the I.C.R. at Truro, N.S., died at his home there May 18th. He was about 64 years of age, and was well and favorably known both in New Brunswick and Nova Scotia. He has been identified with the I.C.R. ever since it was opened and was engineer of the first train over the road, going as far as Coldbrook. He rose in the service, and was for years mechanical superintendent at Moncton. During the past three or four years he has been mechanical superintendent at Truro.

Milton L. Hersey, the well-known chemical expert and assayer, on whom the degree of Master of Applied Science has been conferred by McGill University, is the youngest son of Randolf Hersey, Montreal. His primary education was by private tuition, and he soon entered the Royal Arthur School, from which he was promoted in 1881 to the Montreal High School. From the latter he graduated in 1885, entering the Department of Applied Science of McGill University the same year. Mr. Hersey graduated from McGill nine years ago as Bachelor of Applied Science and has since then held some very important positions, during a portion of the time being connected with the teaching staff of the University. He spent most of the years 1889 and 1890 studying and traveling in Europe and the United States, and on his return to Canada in 1891, he was appointed chemist of the Canadian Pacific Railway. From this position he resigned in 1896 to take up the general commercial chemistry and assaying, but still remains the consulting chemist of the Canadian Pacific Pailway.

F. C. ARMSTRONG.

The Canadian General Electric Company is about to lose an important member of its agency staff in the person of F. C. Armstrong, who has resigned his position of general agent for that company to take up similar work with Dick, Kerr & Co., Limited, London, Eng., well known as a large engineering and contracting firm throughout Europe and the British Empire. Mr. Armstrong is a Canadian by birth. He commenced his education at Peterboro, Ont., with Dr. Tassie, and afterwards graduated from Toronto University. After leaving the university, in 1889, he engaged in electrical work and spent three years of those pioneer days as an electrical and engineering contractor. Since 1892 he has been in the employ of the Canadian General Electric Company, as chief of the agency staff, and during this time not only has he become favorably known to the public, but has obtained a broad technical and commercial knowledge, which no doubt will be of immense benefit to him in his new and larger sphere Mr. Armstrong has prepared at different times several papers for the meeting of the Electrical Association, and has also materially added to its success by his efforts as a member of the Executive Committee. While Mr. Armstrong's departure is to be regretted as being a loss to the country, yet he must be congratulated on the recognition of his marked ability and promotion to the important position which he will hold with Dick, Kerr & Co.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A. ROSS, E.E., M. CAN. SOC. C.E.

The subject of electric power transmissions over long distances has for the last few years been the field in which the most prominent electrical engineers have found a scope for their energies, and the advance in consequence has been most marked. So much so that, while four years ago there was not a power scheme of any magnitude, at the present they are numbered by the score, and are of such size as to utilize an immense amount of power formerly unavailable. A noteworthy point in modern plants is the similarity of the methods in use, especially in America, which is always more given to standardization than are European countries. The several types of alternating transmission have practically crystallized into two standard forms remarkably alike in detail and equally applicable to most cases. The controversies over the relative merits of direct and alternating current for transmission purposes have been settled, and the latter having come out victorious is now carrying the war into the hitherto undisputed territory of the former, namely, the application to general motor purposes, and the results are not doubtful. With the application of alternating current motors to traction purposes, which appears to be not far distant, the last territory held exclusively by the direct current will have been invaded. The reason for this state of things is not far to seek, as the alternating system which formerly was applicable only to incandescent light, has recently made such strides as to prove itself more generally useful for all purposes of transmission and for most cases of distribution than the other. This triumph of the alternating is due to the fact that with extremely simple and durable apparatus, the power is so readily transformed into that form which meets the requirements of most cases.

The efficiency and durability of the newer types of apparatus are such as to leave but scant room for improvement, and it appears probable that unless some fundamental discovery is made, which will render present types entirely obsolete, these forms will persist for some time to come. Accompanying this standardization of apparatus has come a remarkable decrease in first cost and maintenance charges affecting the interest and depreciation accounts correspondingly, and resulting in decreased cost of power to the consumer. In consequence we may expect to see the field of steam generation for many purposes invaded by the simpler, cheaper and more cleanly electric power. If we may judge by present indications, the next phase of the problem to be attacked will be the adaptation for railway purposes of power for large water falls. This only awaits the development of a satisfactory motor for alternating traction purposes, and, from the reports of several recent installations in Europe and the statements of prominent traction engineers in this country, the day of the alternating railway motor for use on the longer railways is not far distant.

To illustrate the methods adopted in transmission work, a few of the larger plants in operation or building are given below.

	System.	Distance.	Voltage.	Horse-power.
Brescia,	Direct cur.	12	15,000	700
Pomona,	Single phase.	29	10,000	800
Fresno,	Three phase.	35	11,000	1,400

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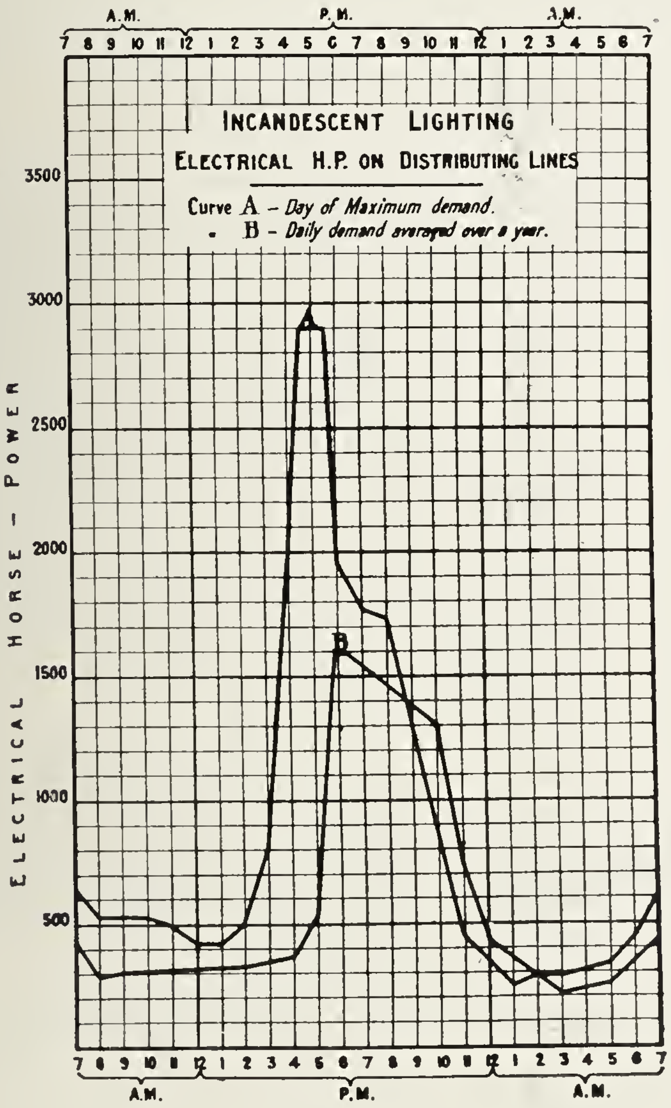
*From a paper read before the Canadian Society of Civil Engineers.

Lauffen,	Three phase.	100	30,000	300	Experimental
Portland	" "	12	6,000	5,000	
Ogden,	" "	38	16,000	3,000	
Three Rivers,	Two phase.	17	12,000	600	
Kootenay,	Three phase.		20,000	2,000	Building.
Hamilton,	Two phase.	38	20,000	3,000	"
Lachine,	Three phase.	5	4,400	20,000	
Chambly,	Two phase.	16	12,500	20,000	Building.

With one exception these are all alternating plants, and it will be noticed that Canada is well to the fore, as might be expected from the almost unlimited powers available. Montreal stands at the head of the world so far as transmitted power is concerned, and it appears probable that the two magnificent schemes at present under construction will find an ample market in the city and vicinity. Montreal's demands, covering as they do the whole field of consumption of power for street railway, incandescent and arc lighting, and motor power, offer a good example for illustrative purposes, and it has been deemed advisable to give point to the discussion to follow by reference to the demands existing in that city at the present time, without reference to future necessities, as these will no doubt be much of the same kind.

With this end in view, the following curves have been drawn, showing the demands for all classes of power at the present time for twenty-four hours.



The higher curve in each case shows the maximum demand during the year, and the lower the average load at each hour of the day for the year. From these demands the transmission scheme will be figured, but necessarily in a general way for illustrative purposes. The problem consists in laying down the power in the city to suit the demands in the most complete way as regards economy, efficiency and suitability. As these demands affect the transmission by their nature, as well as by their amount, they must be considered briefly before taking up the transmission proper.

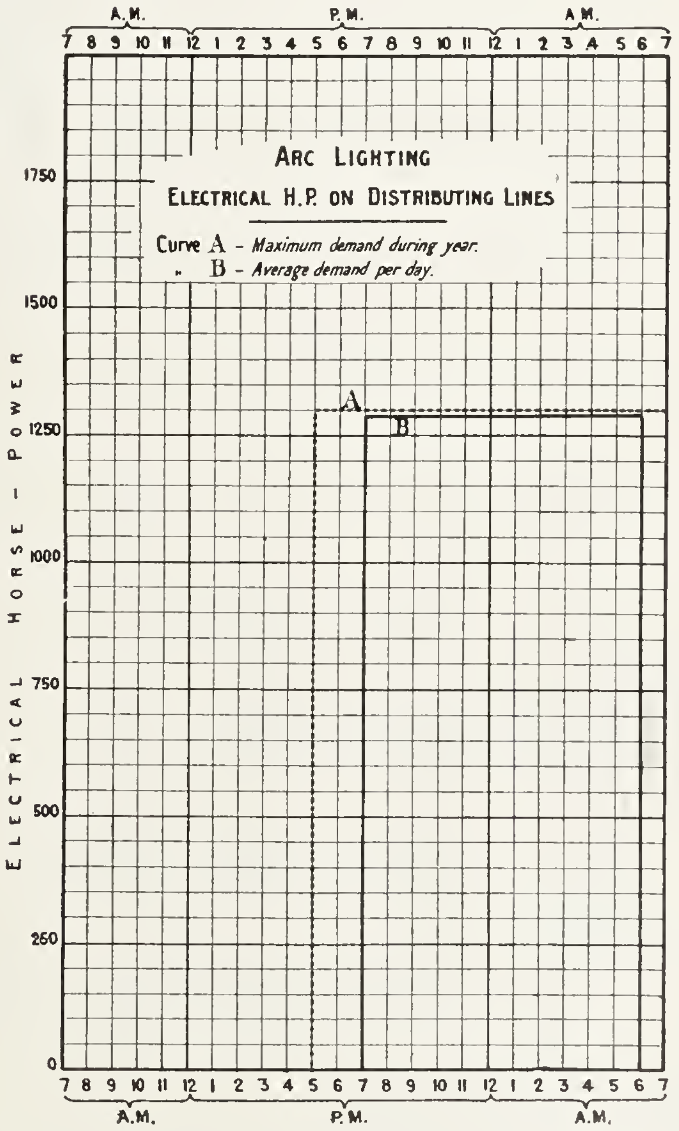
Incandescent Lighting.—The demand curves shown have been figured from the actual curves of one of the present stations in the city, with an allowance for the loads of the other operating companies; in all to cover 100,000 lights wired up. To meet this demand it will be readily granted that direct current is unsuitable, owing to the distances to be covered, and alternating currents of single, two or three phase are the only alternative, any of these being readily obtained from the transmission voltage by means of static transformers to feed the distribution at a voltage of say 2,000, which is considered safe for city work. This potential will of course be again reduced before entering customers' premises, thus involving two sets of transformers. This system will also cover interior lighting by alternating arc lamps, and perhaps a few small alternating motors.

The demand curves for the arc lighting have been figured on the supposition that there are 2,000 arc lamps on series circuits in the city, lighted from dusk to dawn, the curves in this case being elevated into straight lines. For this service several plans present themselves as below.

(1.) By rectifying the alternating transmission currents into direct through the agency of rectifiers, which are simply revolving commutators driven by small synchronous motors from the transmission line, and using this current in the present series arc lamp. This system has been in use for a short time in several European stations, with varying results. It appears to have a great future before it when it has come through the present doubtful stage.

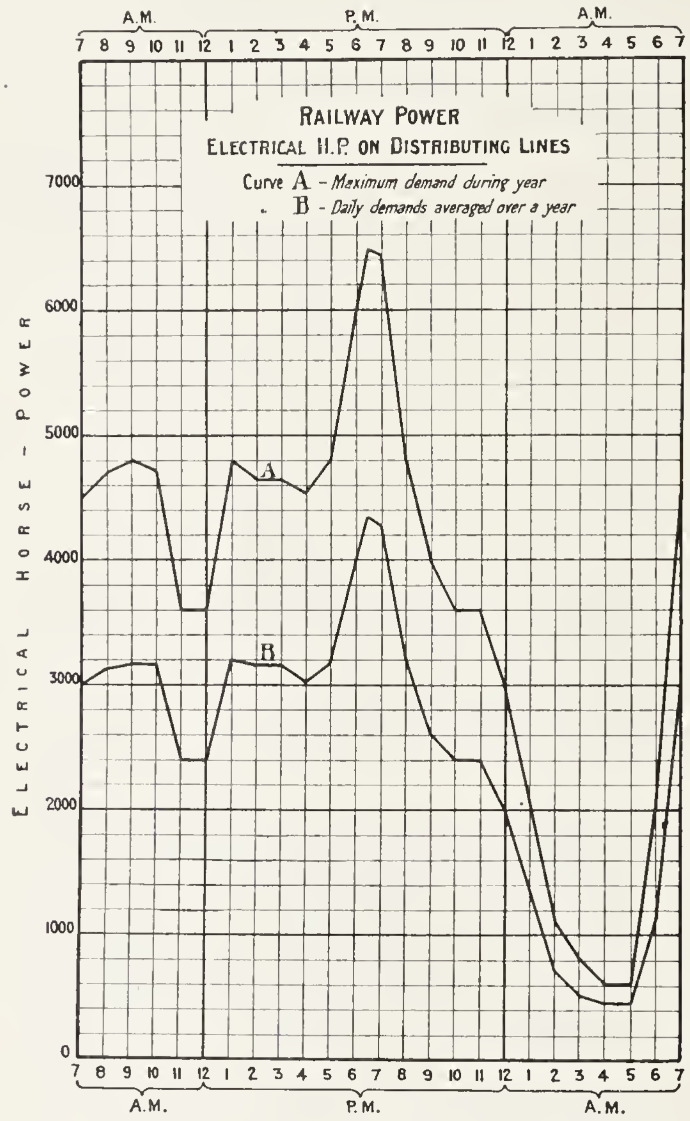
(2.) By means of alternating arc lamps fed from the incandescent circuits. This system, while perfectly applicable for interior lighting, where each unit is treated as an incandescent lamp and turned on or off at will, is not so suitable for street lighting, as it does not lend itself to ready control from the station. Further, as the light distribution of alternating current lamps is inferior per watt of consumption to that of direct, it becomes more expensive in operation.

(3.) The series arc system as at present used, with motors instead of engines to drive the dynamos, while necessitating more apparatus than either of the others, is more simple and controllable in operation, and will be accepted for illustration. The number of units necessary to cover the 2,000 lights will be 16 if of 125 lights each, which is about as high as is available per machine. If these were coupled in pairs to 200 H. P. motors, the units would be eight, and the addition of a spare would make a total of nine, which would be ample for present demands.



Either alternating or direct current motors are suitable for general work, but, where variable speeds are necessary as for elevator purposes, the direct is at the present time the only one available. The cost of the former is also higher at the present time. The advantages of the alternating motor distribution are, less cost of circuits, greater simplicity of apparatus, and the ability of reaching outlying demands at small cost, and that it involves no special apparatus in the distributing station other than the necessary lowering transformers. As the objections to the alternating (on the score of price and unsuitability where speed regulation is required) appear to be within reach of correction in the near future, that method will be adopted for this case. The demand curves are based upon the actual load curves of one of the present stations, with allowance for the other operating companies' loads. In all it represents about 1,100 H.P. of motors installed, to be driven from a two or three phase motor circuit, fed directly through reducing transformers from the transmission line, at a voltage of say 2,000, and again reduced by individual transformers at the motors.

The curves shown in the accompanying figure are the actual records for the past year for the railway company's plant. As at the present time only direct current motors are applicable to this purpose, means must be adopted for transforming the alternating to direct current for the trolley circuit. This is easily accomplished by means of rotary transformers with small loss. These rotaries are practically direct current generators, with collector rings through which the alternating current flows to the windings driving the machine as a motor, while from the commutator connected to the same windings the direct current, which has been commutated from the alternating, flows to the trolley line.



(*Continued in next issue.*)

—The Jas. Robertson Mfg. Co. has issued a very finely illustrated catalogue of the various bath-room, closet and sink fittings which this firm places on the market. The company also manufactures lead pipe, saws, plumbing goods, brass plumbing goods, fence wire, solder wire, triangular bar solder, paint and varnishes, putty, shot and bullets. The nickel-plating plant operated by the firm is on a large scale.

—In the course of a recent address upon building stones by Prof. Julien, of Columbia College, New York, before the Mineralogical Section of the Franklin Institute, some interesting facts were brought out. Professor Julien is an authority on building stones, and an expert in the preparation of thin sections of rocks—sections so thin that they are transparent; and their structure can thus be readily seen under the microscope. On this occasion the thin sections were placed in an electric projecting microscope, and the enormously magnified images were thrown upon a screen. The light was polarized by interposing suitable prisms, and under these circumstances each particle composing the stone revealed itself by its shape and color. The mechanical structure, porosity, density, etc., of each variety of stone were shown, revealing the way in which aggregations of rock particles are sometimes loosely held together without orderly arrangement and with spaces between, sometimes dovetailed into each other, and sometimes cemented together into a homogeneous mass. In some of the sections, which were as thin as a sheet of tissue paper, bubbles of liquefied carbonic acid gas were observed in the cavities of the small crystals. This liquid is held in the stone under pressure, and not infrequently the heat of the electric light, or even of the hand, is sufficient to explode it, shattering the specimens. It was easy to perceive from these illustrations why some building stones will stand great compressive strains and may yet be unsuitable for buildings in these latitudes, while other stones, much weaker inherently, may possess greatly superior weathering qualities. The statement was made that no "weathering tests" of building stones worthy of the name have yet been made. It seems very necessary that this should be done.

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STREET PAVING MATERIALS.

BY J. J. BELL.

It is clear that the experimental stage has not yet been passed in determining what is the best material for street paving. So many points have to be considered—durability, facility of repair, noise, sanitation, cost, etc., that it is difficult to determine what material combines these qualities in the greatest degree. What is suitable for one kind of traffic may be unsuitable for another, what is a success in one climate may be totally unfitted for another, a cost which is possible on a great business thoroughfare, or a fashionable residential street, may be out of the question on the poorer streets, where property owners cannot afford an expensive pavement. A good deal has yet to be done in the way of experiment, and the material employed must vary according to local conditions.

Wood and stone are the two natural materials which suggest themselves for street paving. The noise produced by traffic over a stone pavement precludes its use on residential streets, except in the form of macadam, while wood, so far as used hitherto in this country, is not sufficiently durable for heavy traffic. There is, however, a growing tendency to go back to wood in European cities, especially Berlin, and it is said that before long three-fourths of London will be surfaced with this material. The wood employed there is the Australian jarrah, which has displaced all kinds of wood except Baltic fir, which it is rapidly driving out. Jarrah is an exceedingly hard wood and is said to be equal in wear to granite. It is impervious to moisture, and being a species of eucalyptus is antiseptic and therefore no objection can be urged to its use on sanitary grounds. Another Australian wood, karri, is second only to jarrah, and the Tasmanian blue gum has stood very satisfactory tests in Glasgow. Of course none of these woods are likely to come into use in America, as it would cost too much to import them, where other suitable material is so abundant.

The experience of cities on this continent seems to point to asphalt as the best all-round paving material, cost being the principal objection. Laid on concrete it is durable, clean and easily repaired, and heavy traffic seems to harden and consolidate it. It is liable to rot from water lying on it, but this may be overcome by giving the roadway sufficient crown to allow the water to run off freely and by substituting stone or other material for gutters next to the curb. Asphalt will not answer for track allowances or the strip close to the rails, where the jarring of the cars rapidly disintegrates it, but with granite blocks, or better still, so far as bicycle traffic is concerned, scoria or brick on the tracks, asphalt makes an almost ideal street. An objection is the tendency of horses or bicycles to slip. With a thin coating of ice or snow, or in muddy weather, they are liable to do so, but there are comparatively few days in the year when such conditions exist to an extent to cause inconvenience. An interesting test of the merits of different pavements for slip was made in London, England, some time ago, when a record of the accidents for 50 days showed asphalt 1,066, granite 719, wood 542. On streets of steep grade asphalt cannot be employed. In Halifax concrete is used on grades and asphalt on the level. In New York asphalt is being substituted for granite on some of the streets, the asphalt surface being laid over the granite just as it is, instead of removing it and putting down concrete foundations.

So far as sanitation is concerned, an interesting fact is stated with regard to Buffalo, N.Y., which has more asphalt pavement than any city in the world. It is asserted that since the introduction of asphalt the death rate has decreased, especially among children. This, if verified by the experience of other cities, should go far to encourage the use of asphalt.

Next to asphalt in favor as a permanent paving material, and rapidly winning its way, is brick. In Toronto it is somewhat cheaper than asphalt, and could a good vitrified brick be supplied at a reasonable figure it would come into general use in replacing the cedar blocks which were so extensively laid down some years ago and which have proved such a failure. Brick is somewhat noisy, but it is not so slippery as asphalt, and is easily repaired and durable. A section of brick pavement at the intersection of six streets in Richmond, Indiana, which has been down for six years, and subject to heavy traffic, has not cost a single cent for repairs, and looks as if it was good for six years more. Asphalt and brick are likely to be the two favorite paving materials for city streets in the future.

Macadam will always be employed more or less for roadways. Heavy traffic cuts it up, but by the use of broad tires this difficulty may be obviated to a great extent. No matter how well constructed, the stones are liable to work out, and it is dusty or muddy according to the season. By the use of trap rock, instead of granite or limestone, the highest perfection of macadam may be attained. There is a large deposit of trap near St. Joseph's Island, on the north shore of Lake Huron, which costs little more than the expense of quarrying. An experiment in its use was made at Cleveland several years ago. Two miles of road was made in one of the parks, which has worn well. The foundation is crushed limestone ten inches deep, then eight inches of trap in three layers—coarse screenings, fine screenings and dust—all well rolled. The road cost \$3.10, \$3.19 and \$3.65 per square yard according to grade. Trap is extensively used in Germany, where it has proved very satisfactory. There are extensive layers of trap rock on the St. Lawrence near Kingston, convenient for loading on vessels, and therefore easily available for use in cities situated on the great lakes.

A very unlikely material for paving has been employed in the vicinity of the stock yards in Philadelphia. It is supplied from a plant set up at Norfolk, Virginia, to manufacture the grass that grows in the salt water marshes into paving blocks. The grass is subjected to enormous pressure, and then cut by circular saws into blocks 5½ inches thick. These are treated in three tanks containing different kinds of oil, which renders the fiber supple. A wire helps to hold each block together. The pavement is said to be smooth, noiseless and free from slip. The most remarkable paving material which the readers of this journal probably ever heard of is molasses! In the process of sugar refining in the Southern States large quantities of molasses are produced, which is a waste material, sometimes difficult to get rid of. The head chemist of a refinery in Chimo, Cal., bethought him of a means to turn it to account, and he had a walk, 1,000 feet long, constructed of slabs of molasses mixed with sand. It dried quickly, became hard and was not affected by the sun. A slab two feet long and one foot wide was tested by being placed on supports for a couple of inches at each end. When struck with a heavy hammer it showed no sign of either cracking or bending.

As cost is a very important factor in paving, a statement is appended showing the approximate cost per square yard of the pavements in general use in Toronto. The relative cost will be much the same in other Canadian cities. The figures are for a roadway 24 feet wide:

Heavy asphalt, 6 inches concrete, 2½ inches asphalt	\$2 70
Light asphalt, 4 inches concrete, 2 inches asphalt	2 30
Brick on 4 inches concrete	1 60
" on broken stone	1 45
" on gravel	1 30
Cedar block on 6 inches concrete	1 40
" on 6 inches gravel (wooden curb)	70
Macadam	1 20

THE WHITE SLAVES OF THE PASS.

That there is no slavery under the British flag has been our boast for two generations and we have looked not uncomplacently upon the people of the United States, who by law made all men free and equal, yet for many years bought and sold their fellowmen in the open market. It is no longer lawful for a man to sell himself into bondage, or his wife or children, to pay his debts, but in Canada we have discovered recently that men may be decoyed into the waste places of the earth and there forced to toil their lives out in misery at the pistol's mouth. We quote one paragraph from the voluminous report of the commission appointed by the Dominion Government to enquire into the subject: "We note some special facts, such as, for instance, the fainting of men on the works; the refusal on the part of teamsters, whose wagons were hardly loaded, to give a ride to wounded men, such as young Joseph Bourgignon and Theodore Lambert; some threats of Noble, one of the foremen, to kick them; the alleged bad treatment by the same foreman of men who had had difficulties with the company, and who were discharged one day after they had returned to work; the refusal of food generally to all men discharged or quitting work, and the hardship experienced on account of this, which caused one Weir, for instance, to faint, and others to feel very weak, three men having to subsist for a whole day on one onion; a pinch of salt refused to men leaving camp, which they asked for in order to salt fish they might catch with a fish-hook given them by one of the men. All this when they were at distances ranging from 70 to 150 miles from, and having to walk to McLeod, often having no money, and, even with money, being unable to obtain food, and having sometimes to rely on remnants thrown away on the road." We do not repeat the tale of horror which recites the death from most painful disease of men who passed their last hours under such conditions of exposure to hunger and cold that their companions who were in health could not have avoided freezing except by the most continuous exertions.

The president of the Canadian Pacific Railway when interviewed on the subject is reported to have said that the contractors could not provide feather beds for the laborers. When a public complaint was brought to the attention of Sir Wm. Van Horn's fellow-countrymen, that other great United States railway dictator, Jay Gould, he said, "The public be d——d." The question which should be considered by every thoughtful Canadian is whether we are governed according to the B.N.A. Act or the C.P.R.

SANITARY EXPERIMENTS AT COLOGNE, GERMANY.

BY W. M. WATSON.

The city of Cologne, Germany, reframed its plumbing and private drainage by-laws, some years since, to comply with the fashion of the times, ordering back-air vents on all fixtures, and also traps and breathers on the main line house drains, but, after giving them a few years' trial, it was proved that the advantages of the system were not equal to expectation, or even so good as the method previously employed, which was erecting the appliances with as much simplicity, coupled with good workmanship, as possible, and a short time since the city fathers appointed a committee, together with Herr Maniewski, the leading architect, and Herr Unna, the noted sanitary engineer, to make a thorough investigation of the whole system.

The committee erected sets of soil pipe and drains made from glass; they also had a variety of water-closets, traps and small waste pipes made from the same material, and fixed them to a temporary erection, consisting of three flats, in the most public place in the city. They also got permission to cut out and examine a number of the oldest back-air vents in the city. They had been in use several years. Having lately finished the investigation, their report has been published in detail in No. 4 and 5 of the Gesundheits Ingenieur for 1898, a German engineering journal, and as the experiments are of great importance, the report has been republished in the English-speaking papers. This report relates that all the old back-air pipes the investigation committee cut out were choked up with either grease or coffee grounds, or cobwebs, which would of course prove that the vents had been useless, on several grounds: 1st, Because none of the traps to which they were attached could ever have been in danger of being siphoned, or the back-air pipes would have passed down air to break the vacuum in the waste pipe, and to relieve the draw or suction on the water seal of the traps, and if any air had ever passed down the vent pipes there would have been no cobwebs choking them. 2nd, That they create complications, expensive intricacies and obstructions, interfering with the smoothness of the waste water flow, and are liable to become blocked up with the most poisonous and dangerous part of the sewage, viz., the frothy scum odors.

In the experiments the committee noted the influences of the sewage and air on various sized soil pipes at various grades and inclinations, also in vertical and horizontal position, and studied various sized traps, back-air pipes and connections, and depths of water seals. The influences on the flow of sewage, when the soil pipe was extended through the roof and the end left full open; when only partly open; also when the head of the soil pipe was totally closed up, and when the heads of the soil pipes and the back-air pipes were enlarged in the usual way immediately before passing through the roof. Also the action and influences on the private drains when main line traps and breather pipes were used. They found that a solid piston or column of water was only formed when the waste water from the fixtures was passing through inclined and horizontal pipes. And we know that when a piston is formed that there will be a suction of air or a vacuum behind the column that would siphon the trap or a number of traps, under certain conditions; but as such conditions never occur when the plumbing is installed by a competent person and used properly and in an ordinary way, it is a waste of money and is contrary to sanitary science to use back-air vent pipes.

They appear also to have proved that there is a limit to the pressure of the suction and the vacuums caused by water pistons, which can be overcome by arranging the plumbing so that no inclined branch can be longer than 39 inches, or by increasing the depth of seal in the traps, and by increasing the size of the waste pipes to about three times the capacity of the strainer or the mouth of the inlet. But our experience has proved that all risks can be avoided by making the branch from each fixture as short as possible, and branching them direct and almost level into a line of waste pipe that is extended through the roof, and the end left opened, so that the air can be drawn down when necessary. See illustration and full explanation in the issue of this journal for April, 1897.

The committee found that there was no advantage in increasing the size of the head of the soil or ventilation pipes as is customary at present, except it was possible to decrease the interior by hoar frost in winter, and this they were unable to demonstrate. When water was poured down one of the smaller fixtures it dashed against the opposite side of the vertical soil pipe, and at once resolved itself into fine, single threads, as if delivered from a sprinkler, and the number of threads increased in proportion to the amount of water poured down, until the bore of the soil pipe was entirely filled with thread, which acted as an air injector into the sewers and aerated the waste water passing down at the commencement of its flow towards the sewer mouth. In order to gain a knowledge of the amount of air sucked into the soil pipe an anemometer was carefully fixed on the mouth of the soil pipe above the roof, and one bucket of water was poured down a fixture when the anemometer showed that three cubic feet of air had passed down, and when four pailfulls were rapidly discharged down a fixture there were 17¾ cubic feet of air carried down with the water. Supposing the four pails held two cubic feet then it would prove that the water carried over eight times its own bulk of air with it down the soil pipe into the drains. When water was poured in at the top of the vertical soil pipe the moisture of air sucked in was only half the amount that was drawn in when discharged into the soil pipe through a branch. When the head of the soil pipe was partly closed the number of threads was reduced proportionately, and the seals of the traps showed signs of agitation, and when the top of the soil pipe was closed altogether and the four buckets of water were poured down quickly the water did not break up in threads, but formed a piston which siphoned the traps of all the fixtures except those that branched into a secondary line of waste pipe that had an open end above the roof. When the sewage was flowing through the horizontal sewer it formed a concave surface which largely increased friction and reduced the speed.

When any of the small waste pipes were extended at the upper end and the end left open so that air could pass down when required, the same result was obtained as when experimenting on the soil pipe.

It was shown that when a main interception trap was used, that it not only modified the speed and partly obstructed the flow of sewage, but it prevented any of the air carried down by the soil and other waste water pipes from discharging into the street sewer where its aerating functions are so necessary to commence the purification of the sewage in the drains and assisting in preventing sewer gases generating in the sewers. It was also shown that when the main interception trap is omitted there is a superior and self-cleansing flow of sewage, and that large volumes of air pass forward to the street sewer, creating a healthy atmosphere and circulation of air down the soil pipe through which the fluid is passing, and up other soil pipes that are at the time standing idle.

These experiments, especially those that show that air is carried down with waste waters and that the main trap is a dangerous obstruction, fully explain the reasons why those towns that do not use back air pipes and that extend their soil pipes from the crown of the drains to the highest point of the roof and which make every rain water leader and waste water pipe to pass to the street sewer without any obstructing trap or sharp angles or interruptions of any kind, are almost free from odors in the houses and streets, and free from diseases that can be traced to sewer gas poisoning. While, on the other hand, those cities which have adopted the principle of interception traps, back air ventilation pipes, with all their intricate complications, are often quite the reverse, and of disease a great deal is found among the inhabitants who happen to live in the modern built houses where the obstruction system has been installed. And this is in spite of the fact that the same towns often spend large sums of money in flushing drains and artificially ventilating the street sewers, a thing which is never necessary if the sewers are laid down properly and the straight unobstructed system is adopted. The city of Cologne has now had enough of the complicated system of plumbing and draining and in future will avoid such expensive luxuries and again allow their sewage water to leave inhabited premises with as much expedition as possible, and secure all the aeration it can throughout the journey to the outfall, without making itself a nuisance to the public.

The Cologne investigation has a bearing on sewage purification. It will be remembered that more than twenty years ago Dr. Pasteur, of Paris, and Dr. Warrington declared that sewage contained the necessary organisms for its own purification. Dibdin, of London, England, has shown us the way to compel sewage to clean and purify itself. Adney, of Dublin, has proved that domestic sewage requires three times its own bulk of air regularly and evenly supplied and distributed to every particle or atom of the sewage to enable the friendly bacteria to destroy the poisons, etc., the sewage contains. Lowcock, Birmingham, has shown us a method of applying the atmospheric air to the sewage, and Reid, of Staffordshire, recommends that all sewage should be purified while fresh before putrefaction sets in or sewer gas begins to generate The fathers of the city of Cologne have shown us by their experiments that the sewage will split up into fine threads of spray and take up atmospheric air in larger quantities even than Adney tells us is needed during the time it is falling vertically down the waste pipes. Therefore the bacteria can secure all the oxygen needed for a short period and when the sewage is in a fresh state. If every house rain water leader and waste water pipe were made to form a street sewer ventilator, and the water coming down each of the pipes will bring down four times its own bulk of air, which will go a long way towards providing all the air that is needed to do the necessary work of cleaning the sewage, and in that case the public sewers will be changed from a gas generating chamber to a receptacle for the aeration and purification of sewage and dirty filters, in that case they would be harmless. While under obstructive plumbing by-laws and private drain arrangement of interception traps, no aeration of the sewers can take place, therefore putrefaction immediately sets up and sewer gas is generated abundantly, which poisons the dwellings and the atmosphere of dense populated towns.

The Cologne investigation has demonstrated that most sanitary appliances can and ought to be made of glass, that all soil pipes and lines of waste water pipes should finish with an opening outside, that no rain water leader should join to soil or waste pipe until it reaches a point below the inlet of the last branch pipe coming from the lowest sanitary fixture.

The German scientists are reliable, and their experiments and judgments can be acted upon with safety, and the expensive experiments they have made may be freely taken advantage of by other towns.

THE QUEEN CITY OIL COMPANY.

The location of business houses in Toronto has been undergoing considerable change of late years, and the tendency of trade has been towards concentrating on Yonge street, as near King as possible. Among other well known firms which have moved with the times is the Queen City Oil Co., which has just transferred its extensive business from 30 Front street east to the handsome new Lawlor Building, corner King and Yonge streets, Toronto. The offices occupy the whole of the flat, a dimension of 60 x 90 feet, with 14-foot walls, and are the finest in Toronto for ventilation, light and convenience. They will be occupied by a staff of twenty-five, the hands employed in Toronto, the headquarters, numbering about 200.

The phenomenal progress made by this organization during its history of nearly a quarter of a century is largely due to the tireless energy, conspicuous business ability and unswerving integrity of Samuel Rogers, the founder and present manager of the company. When Mr. Rogers started in the oil business in 1876, he found difficulties confronting him in every quarter. But armed with an iron will, and a resolve to be second to none, he overcame the obstacles one by one. From the very first he determined to encourage Canadian industry, and he has resolutely persevered in that course, to the advantage of the people at large, as well as of the large force of men in his employ.

With the firm, Fairbank, Rogers & Co., he opened a refinery at Petrolia, which has since been merged into the refinery at Sarnia, now the largest in Canada. Although he is now over sixty years of age Mr. Rogers has not relaxed his efforts in one particular, and he is still the central moving spirit in the large and successful company of which he is the founder. He has now associated with him in the company his two sons, Albert S. Rogers, secretary and treasurer of the company, and Joseph P. Rogers, manager of the lubricating department.

The Queen City Oil Company, besides the works on Princess street, Toronto, has branches established in all of the principal towns in Ontario, and sells in Canada the products of the Standard Oil Company. By care in treating the oils they have been able to furnish a product at least equal to the best American oils, and the company has gained the confidence of the public wherever its goods have been offered. The various oils are too well known to need extended mention, Among the best known are the Sarnia White Burning Oil, and the Peerless Oil for farmers' use, one of the best lubricating oils on the market.

Altogether Mr. Rogers is to be congratulated upon the success which has crowned his labors during the past quarter of a century.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during May and the four months ending May, 1897, 1898:—

	Month of May.		Five months ending May.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£7.730	£2,131	£25.647	£10,243
Pig iron	563	569	1,018	5 793
Bar, etc.	316	1,143	4.205	5,110
Railroad	6,935	..	20,286	6,972
Hoops, sheets, etc.	5.436	6,122	16.445	11,592
Galvanized sheets	3,975	6.909	15,998	20,980
Tin plates....................	8 652	21,423	80 972	61,968
Cast, wrought, etc., iron	3,880	3.408	14,965	13.658
Old (for re-manufacture)	....	606	572	1,504
Steel	3 493	4,877	18,480	24,298
Lead	1,672	3,745	4.454	8,050
Tin, unwrought	1,609	3.157	8.923	9,087
Alkali.................. ...	3.533	5,179	11,722	16,737
Cement	1,825	2,771	4,778	8,262

SEWAGE DISPOSAL.

Editor CANADIAN ENGINEER :

My attention has been drawn to a letter published in the June issue of the CANADIAN ENGINEER signed by "Expert," which is false, malicious and libelous in its statements. I hereby ask "Expert" to be manly enough to come out in his own name and repeat his statements so that I may have an opportunity to meet him in the open; I will not brand him as a coward yet until we see whether or not he will have the manliness to sign his own name as requested.

Yours respectfully,
JOHN MACDOUGALL.

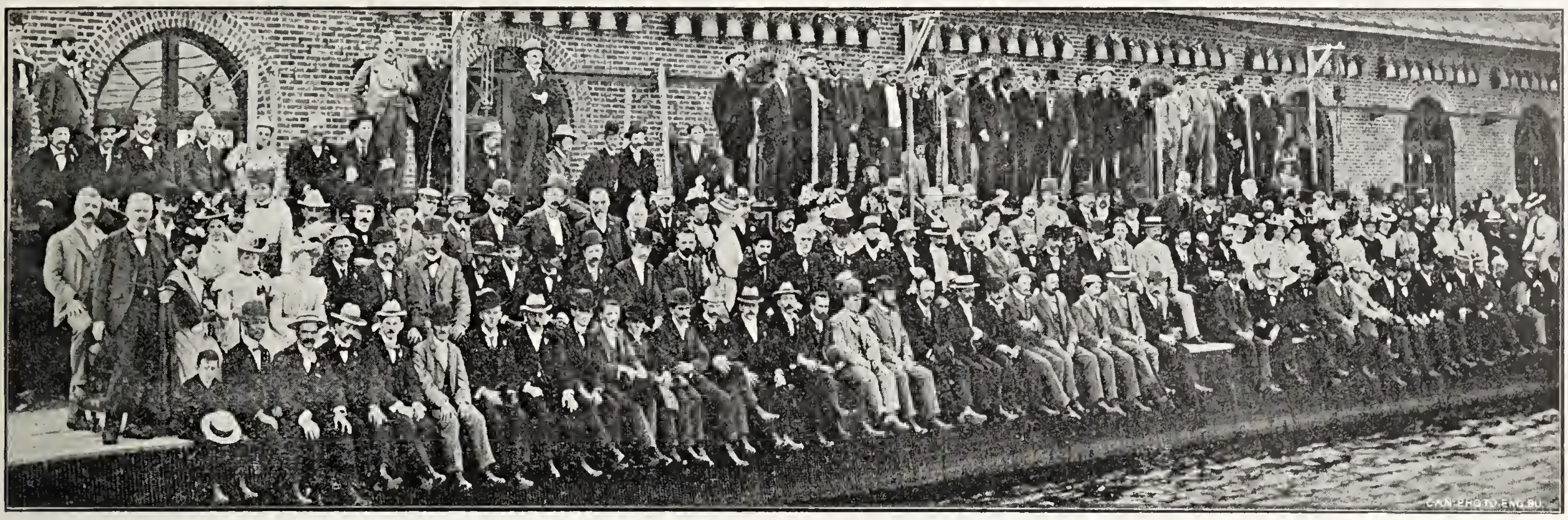
635 Cass Ave., Detroit, Mich., June 22nd, 1898.

Editor CANADIAN ENGINEER :

There is an article in the June issue of your valuable periodical signed by "Expert," which contains misrepresentations of the sewage and garbage disposal processes mentioned therein which I consider to be injurious to the Company represented by John Macdougall, therefore, in justice to that company, provided his statements are true, the writer of the article should have had the manliness to sign his own name instead of a nom de plume. My knowledge of the International processes of sewage disposal and of Warner's garbage destructor, which has been obtained from a long period of study of such subjects, as well as from a personal examination of many works of that character in Great Britain last year, has compelled me to arrive at but one conclusion, namely, that the above-mentioned processes for the disposal of sewage and for the destruction of garbage have no equal either in Europe or America for efficiency and economy in their operations, and I am backed up in that opinion by many of the leading sanitary scientists in those countries, especially in Great Britain. Let "Expert" come out like an honest man under his own name, which he should do if his statements are true.

Yours very respectfully,
J. A. SMITH.

Windsor, Ont., June 27th, 1898.



THE CANADIAN ELECTRICAL ASSOCIATION, PHOTOGRAPH TAKEN ON THE DAM OF THE CHAMBLY MANUFACTURING COMPANY.

CANADIAN ELECTRICAL ASSOCIATION.

EIGHTH ANNUAL CONVENTION.

The eighth convention of the Canadian Electrical Association was held in the Windsor Hotel, Montreal, on the 28th, 29th and 30th June. On the first day, the meeting, which was the best attended in the history of the association, was called to order by the president, John Yale, manager of the Guelph Light & Power Co., shortly after 10 o'clock. After the reading of the minutes of the last meeting by the secretary, C. H. Mortimer, Mayor Prefontaine, of Montreal, was introduced, and welcomed the convention to Montreal. The president said that all were pleased to receive the greeting of the Mayor of Montreal, and called upon A. A. Wright, of Renfrew, to support him in his statement, which he did in a neat three minutes' speech.

The president then read his address as follows: "I beg to give you all a hearty welcome to this the 8th convention of the Canadian Electrical Association. The aim of the association is to gather together the members of the Electrical Fraternity, and allied interests for the purpose of mutual discussion, and to learn from each other's experience. In this way we try to benefit the whole business interests with which we are all connected. An organization of this kind confers upon its members benefits from the reading of papers, and the discussions which take place disseminate information with reference to the methods that are constantly being tried by different members in the practical conduct of their everyday operations and business methods. This association affords the means for members to become acquainted with one another. The friendships here formed should be used for the purpose of mutual protection and advice when difficulties arise. A free and friendly correspondence tends very much to strengthen, stimulate and encourage many of us in our daily struggle with difficulties. It is a matter of satisfaction to me that during the last two years you have honored me with the office of president, good progress has been made in the direction indicated; but there is still room for great improvement.

It is now almost four years since the last meeting of the Canadian Electrical Association was held in the City of Montreal. During the interval conventions have been held once in Ottawa, twice in Toronto, and last year at Niagara Falls. On each occasion matters of current interest and importance have been presented for the consideration of our members. There are many reasons why our meeting, again this year in the east, and particularly in Montreal, should be at once a source of both pleasure and profit to the members of this association. The intervening four years have done much for the Dominion of Canada, for its national life and the development of its material resources. In no department of industry has this progress been more marked than in the electrical field, in electric lighting, in electric railway work, and in the electric transmission of power; and the work must not be forgotten which has been done in extending the use and improving the service in the older branches, the telegraph and the telephone. From this development of the great modern industry in which we are all proud to have a share, no part of the country is likely to reap greater benefits than the City of Montreal and its vicinity.

The Dominion of Canada, at least, so far as Ontario and Quebec are concerned, while otherwise abundantly dowered with mineral riches, has been deprived of coal deposits, until recently an essential factor in manufacturing and industrial development. To-day, however, the possibilities of electrical transmission have rendered available as a substitute to turn the wheels of our factories, the heritage which both provinces possess in their abundant water powers. It will be our privilege to inspect what has been done in this direction by some of her far-sighted and enterprising citizens for the City of Montreal. We shall first see that great enterprise, carried out in the face of difficulties and discouragements, the successful utilization of the power of the St. Lawrence river by the plant of the Lachine Rapids Hydraulic and Land Company. Of equal interest and importance will be the opportunity given of inspecting the plant and equipment of the Chambly Manufacturing Company on the Richelieu river at Chambly, which will vie with its great rival in the beneficent work of supplying cheap light and cheap power for the citizens of Montreal. It is to be hoped that a fair dividend will be the reward of the shareholders of the two companies for their enterprise. It is proper, before entering on the work of this convention, we should glance briefly over the progress of the past year. A marked feature of electric progress in the Dominion throughout the years 1897 and 1898 has been the inception, and, in some cases, the completion of a number of important plants for the long distance transmission of power. In the Province of Quebec there are besides the two plants already mentioned, the Montmorency plant, which has been in operation for several years, and is no doubt familiar to most of you, and the North Shore Power Company, Three Rivers, a 16 mile transmission, 12,000 volts, delivering 500 k.w. In Ontario there is the Cataract Power Company of Hamilton, the distance to be transmitted 33 miles, pressure 25,000 volts with a capacity of 6,000 h.p. This plant, it is anticipated, will be in operation by August 1st next. In British Columbia a transmission installation of 1,500 h.p. capacity is being erected to supply energy for the Electric Railway, lighting and power industries of the City of Victoria, distance 16 miles. The West Kootenay Power Company recently started with an initial capacity of 2,000 h.p., pressure 20,000 volts, distance 30 miles. This power will be used for the operation of machinery in the mining districts. We have already referred to the enormous development under way in the vicinity of Montreal.

The only point at which satisfactory progress cannot be reported is at Niagara Falls, where, unfortunately, the tying up of the greatest water power in the Dominion in the hands of an alien corporation has prevented its development for the benefit of the people of Ontario. This state of affairs, we trust, will be removed before another year. Besides the important plants mentioned which are either in operation, or in course of construction, a large number of similar enterprises are at present in their initial stages and may be expected to reach their completion within the next year or two. Altogether, it is difficult to foresee at the present moment the benefits which our Canadian manufactories and industries generally may derive from the utilizing of the water powers of the country, scattered without number from the Atlantic to the Pacific. In electric railway work the development of the year has been mainly confined to the extension and the better equipment of existing city and suburban roads.

In the field of electric lighting, in which a majority of the members of the association are more particularly interested, a reasonably satisfactory condition of affairs exists. That industry is on a fairly solid basis, at least, in so far as a distribution of current for incandescent and power purposes is concerned, as rendered evident by the failure of the much-talked-of illuminant of the future, acetylene gas, to make any inroad into the field of the lighting companies. A large majority of the plants now in operation are equipped with reasonably modern and efficient machinery, and the rates at which current is supplied are, it is safe to say, if taken on the average, the lowest in the world.

We will have before us the report of the Committee on Legislation. From this you will see how far the efforts made since our last meeting have been successful in the direction of securing equitable protection of private investments. It is to be hoped that the work of the association during the convention will be helpful to the members and that they will recognize the value they receive from their attendance here with respect to the papers which have been prepared for the convention. You will see their practical and helpful nature, and I trust you are ready to criticize and discuss the views set forth in the light of your own experience. One thing more I feel should be mentioned, and that is, the appreciation of the efforts of the different companies and individuals in Montreal who have so heartily co-operated for the success of this meeting. The proverbial hospitality of our metropolitan city is known to you all. A pleasing feature at our last convention, was the regular and prompt attendance of members at all sessions and the keen interest taken in the proceedings. This commendable practice will, I trust, be kept up at this our eighth convention, now open for business.

The president then nominated B. H. Reesor, Lindsay; A. B. Smith, Toronto, and C. B. Hunt, London, as a committee to suggest the names of the Standing Committees.

A. A. Wright, of Renfrew, then read his paper on " How to Overcome Some of the Difficulties Encountered by Central Station Men."

HOW TO OVERCOME SOME OF THE DIFFICULTIES ENCOUNTERED BY CENTRAL STATION MEN.

BY A. A. WRIGHT, RENFREW, ONT.

In treating this subject I shall do so from the standpoint of one who has to deal with customers living in a town of moderate size, and not from that of the owner of a plant in a large and populous city, because the circumstances would be, in many respects, quite different, and the requirements, as well as the mode of arranging the service, would be altogether different. I shall take it for granted that the central station is equipped with an arc and incandescent plant, that the proprietor not only does commercial lighting, but supplies light to the corporation as well.

1st. Let us take up arc lighting on the street. This brings us at once into contact with the corporate fathers, many of whom know nothing of arc lighting, except that it is not only necessary, but their special duty, to appear wise in order that they may look well after the interests of the town.

And now let me make my first suggestion, and that is, that you leave municipal politics entirely alone. If you have an inordinate craving after politics, which you have not the power to restrain, let your light shine before the throne of the Legislative Assembly or in the chamber of the House of Commons, but restrain yourself from meddling with municipal politics, lest you make to yourself enemies who will be sure to avenge themselves, sooner or later, in crippling your lighting contracts with the corporation. I do not wish you to infer from this that you should not exercise your franchise when the day for voting comes around, but on the contrary, let it be known that you and your employees always vote for the progressive and enterprising men of the town, and as every aspiring alderman will want your assistance, you if you do not make too much noise, will generally manage when he is elected to get his. Be careful not to make political enemies but to have as many of the town authorities with you as you possibly can. In most towns the contracts for street lighting are made annually, and not as in cities, for a term of years. See to it then, that your contract is so arranged that it shall terminate on the 1st of March. You can do this by informing the proper authorities that your books are so arranged that your Electric Light year begins on that date. Then see that the following harmless looking saving clause is inserted near the closing part of the contract. "And it is further agreed that either party may terminate this lease at the end of its term by giving the other thirty days' notice in writing prior thereto, and in default of such notice this agreement shall continue in force after the termination thereof, for one year, and upon the same terms and conditions as are herein expressed, and in like manner thereafter, unless such notice is given at least thirty days before the corresponding date in each succeeding year, a like renewal and extension of this lease from year to year shall be considered as made and executed by and between, the parties hereto." Furthermore have your payments fall due quarterly and on the 1st of March, June, September, and December. You know that in Ontario at least, our municipal elections are held at the beginning of the year, and as most of the aldermen will be aspiring to re-election, and would like to have your assistance to re-elect them, they will quite naturally forget, as the term of their holding office is drawing to a close, to give notice of the desirability of terminating that contract, and you almost invariably escape that threatened danger from the outgoing council. Then the new council does not assemble till the last of January and as very little business is done at the first meeting and many of the members are new ones, Electric Lighting is not thought of till your quarterly account is presented in March, when it will be too late to give the required notice, and so your contract runs on in this manner from year to year, renewing itself without any trouble whatever. Another difficulty, which you are almost sure to encounter, is the height of the poles on which your lights are placed on the streets. Some will want 50 ft. poles some 75 ft. and some even higher than either of these. When your contract is made be sure and have the clause worded in this way. "That the hangers from which the lamps are suspended shall be——feet from the natural level of the surface of the ground at the foot of the pole," and not, that the lamp shall be so many feet high, as you will notice that this makes an important difference in your favor. It is well to have it so arranged that you need not run your arc plant on moonlight nights, not merely on account of the direct saving that there is in this, but it sometimes is very convenient, if there are accidents, in giving you an opportunity to make needed repairs.

And now as to your commercial lights. Have your contracts made with your customers on a yearly basis, with same renewing clause that there is in your contract with the town, but with this difference, that the payments in this case be made to you weekly, and then see to it that you make your collections in this way, for a man will frequently pay you a small sum weekly, when he would not pay the same amount if paid quarterly. It may not be amiss to mention that in all these contracts, when stating the candle power of the lamps you are to furnish, that you should be sure and employ the words "nominal candle" power, as it may save you, under certain circumstances, no small amount of trouble also.

And next, as to your incandescent service. This will, of course, be largely, if not entirely, a commercial service. You will have all manner of people to deal with, and you may expect, in many cases, to have your patience sorely tried.

Then to begin at the beginning. Never under any circumstances do free wiring. By that I mean that you should never undertake to wire a house for nothing, in order that you might thus get a customer for your current. Of course you should do all primary work as low as possible, but not at a loss. If your power is at all limited, or if you run by steam, you will find, in my opinion, that you will make more by running your lights on the meter system than you will by giving a flat rate, unless you get an exceptionally good price for them.

I understand that in many places it is customary to take the readings of your meters quarterly, as it thus saves a good deal of time in taking the readings, making out the accounts collecting them, etc. In this, as in other things, the old adage holds good that "Short accounts make long friends." and by no means should you allow your accounts to pass more than one month without being rendered, and if possible collected. It might not be so bad, in the short nights of midsummer, if quarterly collections were adopted, but in the end it will amply repay you to take your readings on the first day of each month, and make your collections on the 2nd.

And now as to the location of your meters. We were instructed when installing our plant to locate them in some out-of-the-way place, where they would not be seen, and high up, so that they would not be meddled with. Now this may all be very good advice in its way, but my advice to you is, not of course to put it in the parlor, or in such a place as to cause it to be an objectionable feature in the household, but, be sure and place it low enough that your man can get at it with as little trouble as possible, and also in a place where there is an abundance of light, so that the readings may not only be taken quickly, but accurately. When you have a large number of readings taken monthly, it becomes a matter of some moment that meters be so arranged that the work can be done quickly and accurately as well. You will be frequently told by your customers that the meter is wrong—that they know they never burned that amount of current. In such pronounced cases as these, when the assertions are very strong, I find it is better at once to say, "Well, it is possible as you say that there is something wrong; you know we are none of us infallible; we will see and have a second reading made at once," and look into the matter and at once, do as you have promised, no matter though you feel almost sure that it is all right. You may find that there is an error, and if so you should of course immediately see that it is corrected, but if you find that the reading is correct, and that Mrs. Julius Caesar still insists that that meter is no good, and declares that the thing runs whether there are any lamps on or not, and tells you in a most emphatic manner that she can hear the thing sing like a rattlesnake, lights or no lights, and she knows that it runs on wheels, what then? Above all things do not allow yourself to answer back harshly, for doubtless she really is sincere in her protestations, and it is not wise to contradict her too rashly. I have found a good remedy in replying that of course it is just possible that the meter is not absolutely correct, but that you feel quite confident that it is, and that to cover just such cases as these the government has appointed an electrical expert, to whom both parties can appeal, and if she, after considering the matter over, still thinks there is something wrong, that you will write and have the inspector come up and examine the meter, and if he finds it wrong, that you will bear all the expenses connected with the inspection, but if it is correct that she is to bear all expenses. Tell her just to think the matter over and let you know, and so far as my experience goes that ends the matter.

Another difficulty that you will doubtless meet when running on the meter system is in having your customers send out of town for 5 c.p. lamps and when only one of these is used your meter will not respond. This you will easily discern when at the end of the month you perceive that no current has been consumed, and I may just here mention that this is another reason for taking your readings monthly instead of quarterly. Such cases are not numerous, yet they do turn up where the family is small and its members are contented to do with a minimum of light. This difficulty can also largely be overcome by making a minimum rate of say 50 or 75 cents per month, which amount can be arranged according as the circumstances of the case may require.

There are of course many other difficulties that central station men have to deal with, but it is impossible to consider many in an article of ordinary length, and the remaining ones will be left for others to treat with, as they, in their wisdom, may see fit.

J. F. H. Wyse, Brantford, said he had been much interested in the paper. He had recently been through the mill in dealings with the Brantford, Ont., municipal authorities. He found the sending of notices, the third being an intimation that the supply would be cut off by a specified time unless dues were paid, was a very effective method of dealing with slow payers. C. B. Hunt, A. A. Wright, B. H. Reesor and A. B. Smith followed in much the same strain. C. B. Hunt then moved and A. B. Smith seconded, a vote of thanks to the reader of the paper and the meeting adjourned.

The members reassembled in the afternoon at 2 o'clock when W. H. Browne, manager of the Royal Electric Co., Montreal, read Louis DeWitt Magie's paper on the "Electric Utilization of Water Powers."

ELECTRIC UTILIZATION OF WATER POWERS.

By L. D. W. Magie.

The utilization of power going to waste in fast running streams has commanded for many centuries the attention of mankind. Regarded, on the whole, as "wasted energy" and as power that could be obtained "for nothing," the question of how to make it useful perplexed our forefathers, and is still giving us some study to-day. Although it would appear that, during the reign of Augustus, about 40 A. D., the first water wheels were made and used by the Romans, the scientific development of the water wheel appears to have been left until the present era, for until within the last few years, comparatively, the only devices used to convert the kinetic energy of streams into effective mechanical energy were the various forms of undershot and overshot wheels. Crude as were these instruments, they have played a most important part in the world's history, for they have done much to develop countries with natural resources. Manufacturers who sought cheap power adopted the "wheels" available and located their plants along favorable streams, where these crude transformers of energy were made to grind corn, saw wood, make cloth, etc. The inventors of the present century awakened to the necessity of improvement and have provided the present types of wheels. To their higher perfection and adaptability is due the fact that almost every power producing stream in settled districts of the civilized world is utilized.

The harnessing of water powers is not an easy task, but requires a great deal of thought, scheming, trying and fitting by the engineer. The records of the stream have to be looked up and studied into, with reference to high and low water, during a period covering many years, and due provision made for getting rid of the maximum flood of every season. The possible storage capacity must be looked after, for oftentimes by a little forethought and a comparatively slight additional expenditure, a stream that naturally gets very dry at certain seasons can be made, by properly arranged storage, to give a practically constant output the year round. Again, by carefully arranging the surrounding conditions, a stream may be made to give for a comparatively short period, when power may especially demand, double or triple its normal output capacity. Probably one of the most important things to study, especially in localities subject to severe winters, is the question of frazile or anchor ice. This is a condition which has caused hundreds of thousands of dollars to be spent, either from the lack of knowledge or want of forethought; in some cases the conditions have been such as to make it almost impossible to successfully cope with them, without expending such sums of money as to practically ruin the enterprise. To overcome it successfully, the only way seems to be to provide a large pond of still water, extending to as great a distance as possible, even several miles, if attainable. Many other details must also be studied before determining the best location of the water motor power house, so as to obtain the greatest available head with the least expenditure. In the study of the question the natural conditions of the soil, water and climate, all have an important bearing, on not only the engineering success, but also on the financial success of the enterprise.

As waterfalls cannot themselves be moved from one place to another, manufacturers have had to locate the sites of their plants at the falls. In many cases it is necessary, and in nearly every instance very desirable, that the power be transmitted to a certain distance. When the distance has been comparatively short it has been accomplished by belting, gears and line shafts, but when the distance extends beyond a few hundred feet, this system becomes so inefficient, expensive or impracticable, that some other way has to be found. Rope transmission has been used quite successfully, even to a distance of a mile, and in a few instances over that distance, but as the best practical efficiency is not over 60 per cent., and the first cost, as well as maintenance, is usually very high, this system has not yet been so successful as to command its adoption very extensively. Compressed air has also been used for the transmission of energy with some success, more particularly in Paris, where there is a large plant still in existence; but here again the engineering cost has been great, efficiencies low, and maintenance high, and consequently, like the rope transmission system, has not met with general use and practice. The electric dynamo and motor have given an entirely different aspect to the transmission of energy. Although invented in the early part of this century, it is, however, only within the last few years that the electric dynamo and motor have been developed practically and commercially. The success and high efficiency attained by electric transmission of energy is such that the "waterfall" is gaining prominence as a source of energy.

The pioneer work in electrical transmission was done with direct current system, and too much credit cannot be given for achievements attained. However, although in a few instances the distance transmittted by the direct current system has been up to twelve miles, yet, on the whole, for commercial reasons it has not been desirable to transmit power by direct current to a distance of over two miles, and even the advisability of this is looked upon to-day doubtfully. The reason for this is not because of the inability to transmit the power effectively, but because of the inadaptability of direct current apparatus for use at high voltages. The construction of direct current machines is such, having, as they do, so many auxiliary parts, that at high voltages they are very liable to break down, especially at the commutator and armature cores, except with very costly construction, and even then they are not at all sure; at high voltages the brushes are liable to spark and cause trouble at the commutator; and as the high tension parts require continual attention and adjustment while the machines are in motion, they are dangerous to the attendants. Probably, however, one of the most important reasons for the inadaptability of direct current machines for long distance transmission at high voltages, is the inability to reduce the voltage to that at which it would be safe to operate at the place of consumption without the use of expensive and cumbersome as well as inefficient banks of motors. Such motors of high voltages, having parts under high tension which require attention and adjustment while in motion, could not or rather should not be used except under the care of expensive special experts in every separate mill or factory where such motors were installed. To place them in the care of uneducated men would be unwise, and, in fact, foolhardy. The highest voltage that D. C. apparatus can be wound for, commercially and safely, seems to be, as universally adopted, from 500 to 600 volts. The reason that power at this voltage cannot be transmitted great distances is purely a commercial one. There is no electrical reason why power by the means of direct current might not be transmitted to an indefinite distance, entirely effectively and successfully. The amount of copper required for the transmission of power is directly proportionate to the amount of power to be transmitted, and also directly proportionate to the square of the distance for a given efficiency. This may be stated commercially by the amount of copper required for transmitting, say, 100 h.p. for both one and ten miles, the loss in transmission to be 8 per cent. and the voltage to be 500 volts. For each leg of a one mile circuit there would be required two No. 0000 wires, or four No. 0000 wires, each one mile long, weighing 15,312 pounds, which at 15 cents per pound would cost $2,300. For each leg of the ten mile line there would be required twenty No. 0000 wires or forty No. 0000 wires, each ten miles long, weighing 1,531,200 pounds, which at 15 cents per pound would cost $230,000; or the power would cost, at 10 per cent. interest and depreciation on copper alone, $2.30 per h.p. annum in the first instance, and $230 per h.p. annum in the second case. If, however, the voltage be raised to 5,000 volts, and be used for transmitting 100 h.p. for ten miles, the condition would be entirely different, for instead of forty No. 0000 wires, each ten miles long, there would be required for each leg but one No. 4 or two No. 4 wires each ten miles long, weighing 15,300 pounds, which at 15 cents per pound would cost $2,300, or the same as transmitting the same amount of energy only one mile at 500 volts.

From the above it will be seen that the transmission of power at 500 volts is not entirely prohibitive for short distances, but as the distance increases it becomes one of vital importance, for the cost of copper is not the only item of expense then to be considered; the pole line itself becomes a very grave matter, especially when we have to consider the weight of forty No. 0000 wires, as in the example for only 100 h.p., and the cost becomes one that investors cannot afford, for the reason that power can be obtained cheaper from other sources, so that commercial transmission of power long distances by direct current at practical voltages is not practicable. Although, as stated before, considerably higher voltage than 500 volts has been used with some success, as at Brescia, the number of such plants are very few. It is a noteworthy fact that on this continent, where the transmission of energy is further advanced than anywhere else, there is not a single plant of any prominence that is transmitting energy by high tension direct current system. It may be interesting to know that three or four years ago, when the Chambly plant was first discussed, a European firm planned out and tendered for the construction of that plant for transmitting the energy by means of this high tension direct current system, but, for reasons as above discussed, that system was not adopted.

How to meet the problem of long distance transmission, commercially and efficiently, has been left almost entirely to the alternating current system. Alternating currents were known about the same time as direct currents, or about 1831, and were explained to the world by the great Faraday, who at that time discovered the elementary principles. From that time on, experiments were made by different inventors on induction coils, but no material progress was attained until May 22nd, 1877, when Jablochkoff obtained British patents for "a new process of producing and dividing the electric light and apparatus therefor." There were also other inventors at about this time who produced "improved induction coils on secondary generators," as some of them were called, but all seemed to have the idea that they could be operated with their primary coils connected in series, and that their secondaries could be independently controlled. In 1878 a J. B. Fuller, of New York, suggested a system of using induction coils or transformers in parallel, but no practical results seemed to have been obtained in this direction until 1882, when Messrs. Goulard and Gibbs exhibited two induction coils at the Electrical Exhibition held in Westminster Aquarium in London, which ran in operation from the Siemens alternator. In the autumn of 1884, Messrs. Goulard and Gibbs gave another exhibition at Turin. In this case, the primary circuit was nearly 50 miles in length. A series of transformers were placed on this line, one being in the Exhibition building, one at the Turin Railway Station at Verine Riesla; another at Lanzo, a small village in the Alps of Savoy; incandescent and arc lamps were supplied at the various places. The first parallel system that was started on this continent was by Wm. Stanley, jr., in 1884, in the small town of Great Barrington, Mass., where light was supplied throughout the town by means of a parallel alternating current transformer system. From about this time commenced the era of alternating currents, although as far back as 1849 alternating current generators were devised. Commencing with 1885 the alternating current system made great strides.

To employ waterfalls as sources of cheap power, high potentials became necessary. For these conditions the A. C. was especially effective; the ability to step up from low potentials to high, and thus transmit power to a given distance, then to step down to safe and convenient voltages, entirely effectively, convenient and without the use of cumbrous and expensive apparatus, rendered the transportation of the energy of water powers feasible and commercial. Probably one of the first high voltage transmission experiments on this continent was in December, 1891, and in January and February, 1892, at Pittsfield, Mass., at which test the writer had the pleasure of participating. The potential used was approximately 15,000 volts. A transmission line about a mile in length was built in an open lot a little way out of town, where a small experimental station was built. The current was received from the local Electric Light Company at 1,000 volts, raised to about 16,000, sent out on the line, and thence returned, again lowered, first to 1,000 volts, and then again to 100 volts, at which voltage energy was consumed in water rheostats. On the line experiments were made with porcelain insulators, as well as the oil type of insulators. At this time, of course, comparatively little was known about electric current at this potential, so that everything had to be handled with gloves, as it were. The experiment proved to be not only useful and satisfactory, but highly successful, and gave considerable encouragement. Although experiments were commenced, and discoveries made pointing to the advancement of A. C. motors in 1879, still practical results of any real value were not obtained until in the year 1890 to 1891, when the poly-phase systems were introduced. From that time it can be truly said that water powers could be utilized for the general distribution of power at distant localities. One of the first and most notable exhibitions of this kind was made at the celebrated Frankfort Exposition in 1891, which proved not only interesting to the town of Frankfort, but to the world at large, for it taught lessons and set aside errors that would have taken years of toil and hard labor to have done otherwise. Poly-phase generators having a total capacity of 300 h.p. were installed at Lauffen and operated by water power. From these, the current was transmitted a distance of 110 miles to Frankfort; several voltages were tried on the transmission line during the experiment, the highest of which was 31,000 volts; in the exhibition grounds were arc and incandescent lamps and small alternating current motors, all provided with current from the hitherto "wasted energy" of the streams of Lauffen, and with a loss of efficiency in the line of not more than 25 per cent., which, at that time, was certainly a most noteworthy accomplishment.

During the next two or three years manufacturers spent a great deal of time and energy in perfecting their systems. The induction motor has been perfected to that of an ideal, and the usefulness and necessity of synchronous motors have been established. For a few years following 1891, an occasional poly-phase plant was put up in different parts of the world. They were subjected to all sorts and kinds of trials, depending upon the character of the work to be performed at each individual installation, and although there was often much cold water thrown upon them at the start, and obstacles placed in their way, still they always came out ahead and proved a success, not only from the engineering point of view, but to the financial backers. When we stop to consider that it has been only within the past six or seven years that a complete system has been devised for the utilization of distant water powers, and that all of the important transmission plants have been put in during that time, it is no wonder that there are yet some sceptics. But perhaps worse for healthful commercial developments are those who make a wild rush for some transmission scheme, without first considering all of its surrounding conditions, thinking that because someone else has made a certain project successful, their project must be also. It falls upon the engineer to bring the sceptic to lines of true reasoning and to teach him facts in their true light, so that he will see and believe, that with such resources at his command, great things are possible; the engineer must also hold the enthusiast in check and prevent waste of money in impracticable undertakings.

The primary or fundamental question is to ascertain the point at which transmission of water powers will be a source of profit to the investor. Many people think that because water strictly follows certain given laws of nature, and in doing so continually and constantly exerts energy, therefore the energy obtained thereby costs nothing. People with such ideas are fortunately gradually growing less as time progresses, although the engineer often encounters men who have a few hundred h.p., or oftentimes when the true facts present themselves, only 25 or 50 h.p., that they wish to transmit five or even ten miles, in hopes of making vast sums of money by the use of this transmitted power in some small town for lighting and power. The cost of electrically transmitted power is represented by the interest on the capital invested; the depreciation; the maintenance; the operating expenses and numerous other small contingencies, and besides, in some cases, the amount of money that has to be expended for water and land privileges. The sum of these accounts per year, divided by the amount of h.p. actually sold, will be the actual cost per h.p. for the case in question. Probably the greatest competitor to electric power is steam power. In a few instances, power derived from gas or petroleum engines may also compete. The cost of producing steam power in any given locality is a fair criterion by which to determine how much electric power should cost. The cost of power produced from other sources can usually be disregarded. The cost at which steam power can be produced in a given locality being ascertained, it can be determined what cost per h.p. may be expended on the construction of an electrical transmission plant to make it profitable to the investor, provided again a sufficient market can be obtained for power. When electrically transmitted power does not cost more than $100 to $140 per h.p. installed, the investment is apt to be a profitable one, providing, of course, it is properly managed.

But what should it cost to harness and utilize water powers ? This is a question that has to be figured out for each individual case, for there are hardly two plants where exactly the same conditions exist. The first item of expense is amount required for water privileges. In some cases this is rather an unimportant consideration, while in others it is the chief expenditure, for it may involve the buying of thousands of acres of land surrounding the stream, because the necessary dams may cause to be submerged a great deal of valuable land, or large tracts have to be bought for building storage reservoirs, or the right of way for pipe lines, etc., have to be secured. When land is cheap, these considerations are often not objectionable, but where good farming land, or land valuable for other reasons, has to be thrown to waste, the question is often a perplexing one. The cost of the dam, power house and hydraulic machinery is, as a rule, dependent almost entirely on the characteristics of the stream being utilized. Entering into the question is the amount of water in the stream, both under normal as well as abnormal conditions at various seasons of the year; also the head or fall and whether it is dependent on natural conditions or requires the building of large dams. Generally speaking, other things remaining equal, generating plants, comprising the power house, hydraulic and electric machinery, as a whole cost less as the head increases, until certain limits have been reached. When the head is low, as ranging from 4 to 10 feet, it requires a comparatively large wheel for a relatively small amount of power, and then slow speeds can only be attained. Where large units are desirable, a number of these wheels must be coupled together in order to get the required power. The speed attainable can be raised or lowered to a certain extent, depending on the size of the wheel. If higher speeds at low heads be desired for large units, many wheels must be operated together, requiring not only a great deal of room, and consequently larger power house, but considerable line shafting, gears, couplings, etc., which not only increase the initial cost, but increase expenditure of operation and maintenance of the plant, as well as introducing another source of inefficiency. With higher heads a larger amount of power can be obtained from fewer and smaller wheels with higher speeds, and, therefore, cheaper generating apparatus.

The cost of generating apparatus for a given capacity, other things remaining equal, is almost directly proportional to the speed at which it runs, and for this reason it is always desirable to refrain from too low speeds wherever possible. There are many people who are imbued with the idea that it is impossible to build a modern station without direct connecting all of their apparatus, and that belting at no time should be used. Although direct connection is desirable, still it must not be carried to extremes. A good engineer will hardly warrant the expenditure of, say, $15,000 for a 300 k.w. generator to run at a speed of say 75 to 100 r.p.m., when a machine just as good in every respect, and sometimes better (because it is a standard size), can be bought in belted units for $5,000. Yet this is sometimes done, burdening the plant with many thousands of dollars on which it has to pay money, for no other reason than that "so-and-so's plant is direct connected and I want a plant just as nice and good as his, and belts are always an awful nuisance." As stated before, direct connected units are always desirable where conditions will warrant them, still it must be borne in mind that belts have been in successful operation now for a good many years, and there are many instances where the maintenance of them has not cost 1 per cent. per annum, and although their use involves a loss of efficiency of somewhere between 2 and 3 per cent., at times of full load, still this loss in a water power plant is not a critical amount, and in fact is almost always inappreciable.

The next item of considerable expense is the transmission line—always rather an uncertain item, on account of its variations in cost for different distances and the conditions of local distribution. The poles, with their appurtenances, exclusive of wire, will cost between $250 to $500 per mile, varying according to circumstances. Rights of way for the placing of poles may often be expensive. The transmission wire must be considered separately. Reference has been made earlier herein to the voltage or size of wire. The voltage at which it is practicable to run now-a-days is reaching vast proportions. There are two or three plants being installed in which 20,000 to 22,500 volts will be used, and a plant is likely to be installed soon that will use 60,000 volts. The use of high voltages in the past has been limited greatly by the insulators. The glass insulator has proven itself insufficient for most climatic conditions. The oil type of insulators was introduced some years ago, and a great deal expected from them. They did give excellent results in the laboratory, but unfortunately the oil evaporates and the impracticability of renewing the oil, especially when the line is in use, soon put them in disfavor. Porcelain insulators appear to have solved the problem. The trouble at first was to get them properly vitrified, but this difficulty seems now to be overcome, and the insulators have proven all that can be desired when used with the usual voltages now employed. As to whether they will successfully cope with the higher voltages now contemplated is a question yet to be answered. The cost of the transmission wire is often the most important part, but it is always different with each case, dependent, as it is, upon the amount of power to be transmitted, the transmitting voltage, distance, and the allowable loss. As a whole, it is always best to keep the transmitting voltage as low as possible and still keep within commercial conditions. Many people are carried away with the idea that if they could only use high voltages the cost of transmitting would be reduced to a minimum. It must be borne in mind that with the use of the higher voltages the cost of insulators increases, the electrical apparatus necessarily costs more, and moreover, the risks are greater throughout the system, and consequently necessitates more skilled attendants to look after the plant.

All of these items have to be carefully considered before looking into the possible saving of copper on the line. For mechanical reasons, a wire smaller than No. 6 B. & S. should not be used for line work. More cautious engineers will say it should not be smaller than No. 4 B. & S. It is foolish to attempt to use voltages which allow the use of smaller than No. 6 wire. Where a shut-down would mean heavy damages, it might be even advisable to use a wire not smaller than a No. 2 B. & S. If these facts are always borne in mind, the question of voltage will oftentimes adjust itself, and the use of very high voltages will not be found necessary unless the transmission be for especially long distances, and the amount of power particularly large. The permissible drop is dependent upon the power obtainable at the generating station and the amount to be delivered at the end of the line. There are a few instances where power is scarce at both ends of the line, and where it is desirable for this reason to keep the loss of transmission as low as possible, but such cases as a rule are rare, and we are more often met with the reversed conditions. To get good results electrically, the loss in the line should not be more than 15 per cent. If it be more, it will, with the other losses that are necessary in the rest of the apparatus, especially where the load is liable to be a fluctuating one, render good service almost impossible. The figuring of drop on transmission lines should always be left to competent engineers, for with A. C. the question in many instances is not a simple one, because it involves other conditions besides the ohmic drop. When alternating current is sent through a conductor, it has to deal not only with the electric resistance of the wire, but also with a resistance due to the fact that the electric magnetic stresses set up at any point of the conductor, create electromotive forces at other points of the same conductor, which oppose and retard the passage of the current, or in some cases, tend to shove it ahead. As to how far power can be transmitted, the engineer can conscientiously say to an indefinite distance, and he would be fully prepared to figure out, and contract for, if necessary, the fulfilment of his statement, but it rests with the commercial men to cry halt. The distances attainable, however, on a profitable basis, have been growing greater from year to year, as the manufacturers have been prepared to extend the limit to which they are willing to build high tension apparatus. At present it would appear that where the distance to be transmitted is over 75 to 100 miles, no matter how cheap the hydraulic development, commercial competition is not practicable with existing power where coal can be obtained for $2, $3 or even $4 per ton.

The step-down station and the distribution of power are the next items of expense, including the cost of the necessary switchboards, transformers, etc. The location of the step-down station and the method of the distribution of power constitute a very important question. Unfortunately, very often this subject is entirely omitted or overlooked by the promoter, but it is one to which should be given considerable thought. The step-down station itself should be centrally located, so as to make the distributing lines as short as possible. It is not generally advisable that transmission lines of very high voltages and large currents be extended through thickly settled communities where they might be liable to disturbance from fire or accidents of similar character, in the immediate locality of the line. In some places, to enable the distribution station to be centrally located, transmission wires are placed in conduits underground, when they pass through thickly settled districts so as to avoid the danger that would otherwise exist, but this, of course, is expensive construction, and the cost of it must always be balanced against the advantages of having the step-down station centrally located, as against its being placed at the outskirts of the town. All the various items require careful study to obtain least cost and avoid unwise economies.

When all these various factors have been properly adjusted and the resulting condition of the water power electric plant is that the power available twenty-four hours every day is at or about the cost of steam power in any given locality, the future profitable operation will be, no doubt, assured, because the popularity of electric power is not due alone to the fact that it can be produced cheaper than power obtained from other sources, but also to its superiority in other directions. This is evidenced by the fact that in mills and factories, where both sources of power have been tried, electric power is displacing the steam plant. Owners having experience with both invariably state that they would not be willing to return to their former power plants, even if power could be produced as cheap or cheaper than they are now obtaining it for electrically. The reasons for this are very numerous. The power is always on tap day and night, year in and year out; there is no waiting for boilers to be fired, nor shut-downs on account of strikes at some distant coal field; less room is required, and consequently floor space formerly occupied by belts and shafting can now be easily sub-divided into any number or sizes of units, and thus independent departments and machinery can be worked separately instead of from one big unit. Overtime work in any department is much cheaper, for by having departments separately operated they can be run independently at will, without running all the other machinery in the mill. The fire risks are less, and rates of insurance less for mills operated electrically than by other means. Removal of so many belts, line shafts, pulleys, etc., secures less danger to life of mill employees, and the mill is lighter and cleaner, and consequently the health of operatives better. On account of the extreme simplicity of the A. C. electric apparatus, anybody with ordinary intelligence can start it in motion, and thus avoid depending on one or two men. Moreover, with electric power it is possible to maintain a closer speed, which in many instances enables the turning out of a larger quantity of better product commanding higher price; and so on for most every department and branch of business, some advantage is gained without anything lost. All of these advantages are not evident to the consumer before or when he first puts in electric power, and he often refuses to listen to them, thinking that they are entirely imaginary, but a short experience brings the conclusion that electric power is "cheap at any price." It may be interesting to note here that there is a project now on foot in which it is contemplated to transmit 30,000 h.p. a distance of between 30 to 40 miles; the transmitted power to be used in mills now operated through shafts, gears and belting by water wheels, because of the advantages to be gained by using electric power.

The use of electric power is not confined to driving machinery in mills or factories, for it is fast finding its usefulness in other directions. The use for "electro chemical" enterprises is fast reaching vast proportions, and there are plans now on foot for the utilization of at least 150,000 h.p. in this way during the next two or three years. There are many thousands of h.p. being used in the street railways, while the big trunk lines are seriously considering its use, and are continually asking the manufacturing companies for plans and estimates. Then there is the electric welding, the electric plating, the supplying of energy to horseless carriages and electric launches, to say nothing of the hundreds of thousands of incandescent and arc lamps that are used for general lighting. The utilization of the water power by electric transmission has not stopped with the commercial world, but has forced itself into the privacy of our own homes, not merely with incandescent lamps, but with electric cooking utensils, smoothing irons, electric heaters, fan motors, etc. What would our forefathers say if they were told that to-day we are depending on such and such a river, so many miles distant, to cook our meals for us and to have our boiled shirts laundered; but we had better not laugh now, for the coming generations may have as much occasion to laugh at us.

This paper was so admirably read that A. A. Wright jocularly asked whether the position of permanent reader to the association was open. If so Mr. Browne should be asked to take it. Wm. Thompson, Montreal, regretted very much that Mr. Magie's paper, which covered the whole ground before him, had not reached the hands of the members before the day of reading. He (the speaker) was only about 30 years old, but he could remember his grandfather running a mill in England by one of those lovely water wheels on which the water dropped from a great height above. Some friend came along and said, why don't you put buckets on your wheel and catch the water, thus suggesting an improvement which waited years for adoption. Mr. Magie properly pointed out that water motors for electrical transmission had come to stay, and was wise in pointing out to the investor that there are occasions when an electrical installation cannot pay. It is a pity that the installations near Montreal are not more advanced so that the investor could see what returns are likely to be made. The Lachine plant, for instance, represents a large capital that will be locked up there for years to come. In conclusion he felt like proposing that the discussion of this paper be postponed till next year, so that members might have a fitting opportunity of studying it. W T. Bonner, Montreal, thought that the steam men had been slightly disparaged. He expected that during the coming six months some tests would be made of important existing plants which would educe surprising results in favor of steam. He hoped to submit them at the first opportunity. W. H. Browne, Montreal, objected to the postponement of the discussion as it might bring on new phases of the subject and there were several members present who were capable of discussing the paper. He was perfectly aware that steam plants showed up very well in comparison with electricity, and indeed the paper pointed out that the initial cost in many cases rendered the installation of electricity prohibitive as an opponent of steam. But the use of the steam plant at unaccustomed hours involves extra cost while that of electricity does not. The largest commercial enterprise in Montreal has negotiated for electric power and has altered the working hours so as to recoup itself. A. A. Wright, Renfrew, thought the subject, in this age, of the utmost importance. Small towns in particular would be much benefited if the water powers in their vicinities could be used. A. M. Wickens, Toronto, also regretted that the paper had not been handed in earlier. Much could be said in favor of the steam end of an electric plant. You see, he said, this association reaches from one end of Canada to the other and includes many districts where there is no water power, and in such places the steam engineer will crowd his electrical rival very closely. Even where there is water power the results are not absolutely convincing. Take, for instance, the Cataract Construction Company on the American side of the Niagara Falls. No one knows whether they are making anything or not, or what the cost of transmission is. We know that a vast sum of money is sunk there, and that so far very little power is transmitted to Buffalo. About everything else we are left in doubt. J. J. Wright, Toronto, endorsed much of what had been said, but fancied that the steam engineers were not quite so sure of their facts as the electrical. L. De W. Magie said that if it had been his intention to fight the steam men he should have written a different paper. W. Thompson, Montreal, said that Mr. Magie had made his statements mildly, and agreed with much the writer said. The trouble is we put in 20,000, 30,000, or 40,000 h.p. plants and we are able to find customers only for about one-tenth. Too many people imagine that because the waterfall turns the wheel that therefore power ought to be free. Where large installations have been attempted too much money has been sunk to obtain power vastly in excess of the demand. Montreal is of course exceptional because of its promise and opportunities. Still it is not exempt from the charge. B. H. Reesor, Lindsay, moved a hearty vote of thanks to Mr. Magie.

W. T. Bonner, Montreal, then read his paper on "The Unconscious Ownership of an Important Key."

THE UNCONSCIOUS OWNERSHIP OF AN IMPORTANT KEY.

BY W. T. BONNER, MONTREAL.

The first consideration in exploiting any new suburban tramway is the possible or available passenger traffic. That being found inadequate to guarantee a fair return on the cost of installation and maintenance, the project is usually abandoned for the reason that only passenger traffic can be considered, owing to the high cost of handling goods traffic at the terminals. While a motorman and conductor are sufficient to handle a two or three-car electric train for passenger traffic, with very little expenditure of time or assistance for loading and unloading, all railways under present systems require a large additional force to conduct the hundreds of details attending the reception, checking, loading, transferring, unloading and proper delivery, in good order, of either car lot or package freight. It may therefore be conceded that the whole subject presents two phases of commercial economy, viz.:

(a) From the standpoint of the agriculturalist and land owner; how best to provide a means for increasing the value of remote lands.

(b) From the standpoint of the capitalist; how best to increase the earning capacity of suburban lines.

With the ever increasing centralization of population and commerce, inaccessible property becomes less valuable; all land, whether barren or fertile, suffering alike, according to its distance from the centre of demand for farm products, which we call markets. Such distance is not always measured in actual miles, but rather in accessibility, since in our day we find frequent examples of the long and short haul rates. The Minnesota and Manitoba farmers will deliver their wheat at the seaboard at a lower cost per bushel than the farmer who may live a hundred miles off the coast. The eastern farmer may have just as fertile land as his western competitor, but he is handicapped by having to haul his wheat forty or fifty miles over poor wagon roads to reach the nearest railroad. In either case, the terminal charges, including the cost of loading the produce at the farm, is approximately the same, but the difference in cost of haulage per ton-mile by railroad and wagon road is in favor of the former. It has been stated as a fact that to transport a ton of coal from Buffalo to Chicago costs no more than to move the same quantity of coal across the sidewalk in either city. It is frequently asserted that since the introduction and development of steam railways, they have gradually superseded the earlier methods of transportation and traffic, and as a consequence highways are no longer an indication of progress. This is true only to a limited extent. Railroads have changed the character of suburban traffic, and personal travel is no longer dependent upon the condition of the highways, but commercial intercourse, as represented in the exchange of products, is as much dependent upon the condition of the public road to-day as it ever was, for the reason that it is impossible to construct a railroad to the door of each producer and consumer.

Few people have any knowledge of the real cost of transportation by horse and wagon. The following table shows the cost of moving a load of one ton a distance of one mile on level roadways, with different pavements and under average conditions:

	Per ton-mile
Iron Rails	$ 1.28
Asphalt	2.70
Stone, paving, dry and in good order	5.33
Stone, paving, ordinary condition	12.00
Stone, paving, covered with mud	21.30
Broken stone, dry and in good order	8.00
Broken stone, moist and in good order	10.30
Broken stone, ordinary condition	11.90
Broken stone, covered with mud	14.30
Broken stone, ruts and mud	26.00
Earth, dry and hard	18.00
Earth, ruts and mud	39.00
Gravel, loose	51.60
Gravel, compacted	12.80
Plank, good condition	8.80
Sand, wet	32.60
Sand, dry	64.00

From the foregoing table, and from statistics gathered by both state and national bureaus, it has been calculated that the average cost of transportation by animal power is twenty-five cents per ton per mile. Furthermore, the rate of transportation by animal power is, and always has been, excessively high, and the evidence of statistics shows but slight improvement as compared with the progress made in other departments of industry, and by other means of transportation.

One fact is patent to all, that whereas formerly the distribution of population was approximately equal over the face of the country, it is gradually becoming concentrated into large cities to such an extent that already fully one-half of the inhabitants of the older sections of the country live in cities. The evident reason for this is competition, the demand for increased output at reduced cost. Concentration indicates increased power for production. Take, for instance, some of our commonest staples, like wheat, beef, pork, molasses, wagons, horseshoes, butter and clothing. Within the writer's memory, these articles were produced at homes, or in small shops and factories distributed, like the population, quite equally throughout the country at cross roads and villages, utilizing crude methods and operated by the old-fashioned treadmill or horse power, and overshot water wheels. The output of flour per man per day in those mills did not exceed ten barrels. At the great Winnipeg and Keewatin mills, and at Minneapolis, the milling business has been so concentrated that to-day the output per man exceeds 100 barrels and the cost of production is correspondingly reduced. But of what benefit to inaccessible property in the interior is this reduced cost of production, unless like facilities for transportation are afforded ?

The measure of benefit which any improvement in production in one community bears to another community, depends entirely upon the transportation facilities between the two places.

Concentration of population and production requires for the better equalization of supply, and price of materials and provisions, that such centres must be provided with commercial veins and arteries which shall quickly and cheaply transport or exchange urban and suburban passengers and commodities. While long haul rates of transportation by railroads and steamships have been wonderfully cheapened, there still remains a space of fifteen to twenty-five or even forty or fifty miles surrounding every commercial centre, which has never been covered by any cheap method of transportation. Such distances are beyond the possibility of cheap or efficient service by animal power, and the terminal charges and bulky plant required, precludes any possibility of much reduction in railroad tariffs. What we require therefore is a new system of transportation which shall be alike available for freight and passengers. The problem of handling exclusively passenger traffic is comparatively simple; indeed it has already been solved for those districts where the population is sufficiently dense to support steam or electric tramways requiring no other source of revenue. Experienced railroad men are unanimous, however, in agreeing that no road, whether steam or electric, will pay in a thinly settled district, unless assisted by a bonus or by the addition of freight traffic.

The latest development in the line of providing for goods traffic on electric tramways came to the writer's notice some months ago in the shape of a combination vehicle, so constructed as to be readily convertible for use upon any ordinary roadway or upon a railroad track. It can be shifted from one to the other without the necessity of reloading or rehandling the contents between points of shipment and destination. The wagon proper is patterned after the ordinary improved road wagon, modified, of course, for the special nature of the service contemplated. The running gears and springs are of standard construction, having a carrying capacity of from three to seven tons, depending upon the class of freight to be carried.

The rail truck is not materially different from the car truck in general use upon our electric railways, except that it is provided with special attachments for automatically gripping and supporting the wagon proper. It has cast steel segments or dogs, supported in place horizontally by heavy plate springs, and used for the purpose of engaging the axles of the road wagon as the truck approaches from either direction. As the truck is drawn forward on the level rail by the electric motor, the impact of the projecting dogs against the wagon axles also starts the wagon forward, and as the latter travels down the inclined switch track, the axles gradually settle into the notch provided in the cast iron journal frames.

The actual time required for unshipping the wagon from the truck for road use, and vice versa, is not more than would be required for coupling together cars in making up a train. The weight of the combined wagon and truck is sufficient to insure perfect rail traction and the proportion between carrying capacity and dead weight averages about the same as the ordinary freight car. By establishing a uniformity of dimensions and making the rail truck interchangeable, the wagons can be loaded either end on from either direction, and any number of rail wagons can be connected and moved in either direction as a train, by steam, electric or other motive power.

W. H. Browne said Mr. Bonner had submitted a conundrum. He took it as a suggestion that the railroads should lend their lines for the transmission of parcels free, and thus make unnecessary the aggregation of population in large cities. G. H. Hill, Montreal, said that while the scheme was, no doubt, an interesting one, it was open to question. It proposed to do away with the frequent handling of products and seemed beautiful up to the point where the car is sidetracked. But it means the lying idle of a certain amount of rolling stock, and it is a question whether the producer could not bring his stock down to a certain point where it could be taken up by the train. Then he loses the ownership of the material the moment it leaves his yard. Now the railway company is not going to do the work of a commission agent for nothing. The speaker had run over a number of suburban routes, noticeably that of Grimsby, where the system seems to give first-class results. They run through a most fertile country tenanted by large fruit growers and farmers, who all need a certain amount of power at all times—threshing, pumping, churning, and yet strange to say the suburban company will not even think of taking power from their circuits. In Manitoba and the North-West Territories he knew of a scheme which was being evolved by some engineers who figured out that the farmer of Manitoba, with the straw annually burnt up, could do all the work of his farm by electric power. The discussion was continued by A. A. Wright, J. J. Wright, L. De W. Magie, C. H. Wright and W. H. Browne. G. H. Hill moved and E. D. Ellis (Barrie), seconded a vote of thanks to Mr. Bonner. The president in tendering the vote remarked that before you could get the farmers to use power you must have some model establishment showing what can be done.

A telegram from John Murphy, on behalf of the Ottawa Electrical Association, was read, wishing the association a profitable and pleasant convention in the commercial metropolis of Canada.

In the evening, on invitation of the Montreal Park and Island Railway, the members enjoyed a trip around Mount Royal, where a good view of some of Montreal's handsome suburbs was obtained.

WEDNESDAY, JUNE 29TH.

The first business of the day was the presentation of the Secretary's report, from which it appeared that there had been five committee meetings during the year ending 31st May last. At the first a Committee on Mileage and Transportation was appointed. At a later meeting committees on general arrangements and on papers, and the secretary was instructed to render accounts to members in arrear for fees and make drafts if amounts were not paid within reasonable time. At the meeting of May 25 nine persons were elected to membership and the resignation of ten members accepted. In the early part of this year a pamphlet setting forth the character and purposes of the association was prepared and printed under the direction of the Executive. About 800 copies of this have been judiciously distributed. Particulars of other important work are to be found in the report of the Committee on Legislation. Incidental reference was made to the recent formation of the Maritime Electrical Association, of which F. A. Bowman, of New Glasgow Electric Company, a member of the Executive of the Canadian Association, is the president, to promote electrical interests in the Province of Nova Scotia and New Brunswick. During last year death entered the ranks of the association and caused the loss of Charles Ernst, of Detroit, and Ross McKenzie, of Toronto. During the year there were dropped from the roll the names of 21 members, 12 active and 3 associate members having resigned; 2 having died and 4 having changed their place of residence without furnishing their new addresses. Since the 1st inst. 2 additional resignations have been received and the names of 13 members struck off the roll for non-payment of fees. Thus there have been removed from the membership list since last convention 36 names. During the same period there were added 68 active and 11 associate members—a total of 79, leaving the present total membership at 234. The Financial Report for June, 1897 to May, 1898 shows total receipts $790.82 including a balance at the bank of $410.57. Bringing the financial operations up to June 29, the total at credit of the asociation is $588.75. The report was adopted, and the secretary thanked for the care with which he had prepared it.

REPORT OF COMMITTEE ON LEGISLATION.

Your Committee beg leave to report that in pursuance of the motion passed at the last convention held at Niagara Falls, instructing your Committee to take up the matter of securing legislation in connection with the movement among municipalities in Ontario to enter upon electric light undertakings, in unfair competition with companies already in existence, your Committee held their first meeting at the close of the convention. At that meeting it was decided to procure an opinion from Donald Guthrie, Q.C., ex-M.P.P., of Guelph, and to retain him professionally on behalf of the Electrical Association in connection with the question. Various questions were submitted to Mr. Guthrie, and his opinion in answer to these questions was considered at a meeting of your Committee held in Toronto on the 9th of November.

A bill was prepared which came before the Municipal Committee of the Legislative Assembly on the 12th of January. Your Committee in preparation for the meeting, assembled in Toronto on the 11th, and also on the 12th, and attended the meeting of the Municipal Committee for the purpose of supporting the bill. The Committee had also the assistance of Z. Lash, Q.C., with Mr. Guthrie.

After discussion, those representing us consented to a suggestion of the Honorable A. S. Hardy, Chairman of the Municipal Committee, and other members of that Committee, to allow the matter to stand over for another year. The discussion, however, brought out the fact that there was really no sound answer to the principle of the proposed measure. It also evoked an expression of opinion from the leading men of both political parties to the effect that the underlying principle of the bill was just. The Municipal Committee thought that there was not proper time to consider how the bill would affect places where there were more than one existing plant, also places that derived or may derive power from points outside the municipality, also to consider the length of the life of an electric plant and other questions, and in the judgment of the Municipal Committee any bill dealing with the matter would require more ample public discussion and some modification. The action of your Committee and the discussion the question has received, has tended to bring into prominence the injustice of the present law. The necessity and propriety of some measure of relief may be considered now to be more generally admitted. The work thus inaugurated and which has attained a hopeful position, should not be discontinued. The present law of Ontario is inequitable towards lighting and power companies, because it permits a municipality, after it has given its sanction to the formation of such a company and has encouraged enterprising citizens to embark their capital in it for the purpose of supplying the municipality wtih light and power, to turn around and destroy, with public funds, and without public necessity or advantage, the value of the property of those citizens who were encouraged to invest their private means in the enterprise. What evidently struck the majority of the members of the Municipal Committee was that the proposed legislation was just and equitable because, while it did not prevent municipalities entering upon municipal supply of lighting if they so desired, it made provision for extending the existing law regarding water works to the case of lighting companies. This law is to the effect that where a municipality desires to supply water and there is an existing water company incorporated for the municipality, the council shall not levy any water rate until the council has, by by-law, fixed a price to offer for the works or stock of the company, nor until after thirty days have elapsed after notice of such price has been communicated to the company, without the company having accepted the same or having, under the provisions of the Municipal Act as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid or has been secured to the satisfaction of the company; the price to be determined by arbitration under the provisions of the Municipal Act. It will be observed that this provision in no way interferes with municipalities going into the supply of water. It simply provides that if they do enter upon such undertaking they are by this law bound first to try to buy at a fair price, or at a price to be fixed by arbitration, existing waterworks. No good reason can be advanced why this law should not be extended to lighting and power companies as well as to waterworks. It is eminently just, and it imposes no hardships on the municipalities; nay, rather, it benefits them, because it tends to extinguish rivalry to themselves, which rivalry might render municipal operation of these works unprofitable, and at all events it puts them in possession, at a fair valuation, of the very plant and material that they would have to purchase from other people if they are going into the business. The proposed legislation is in the public interest, because it will further encourage private citizens to invest their capital in extending and improving existing lighting and power works. It was generally acknowledged by the Municipal Committee that electric light companies as well as water companies have always come into existence with the consent, encouragement and approval of the municipality, which has granted the use of the streets, etc., for these works.

It ought to be mentioned that all the members of your committee paid their own traveling and other expenses in connection with attending the meetings. The movement amongst municipal corporations to enter into the lighting and power business in competition with those who had the courage to be pioneers is growing, and unless regulated in some way by the legislature, will result in the confiscation of a large amount of capital invested in the business, as witness the town of Barrie now preparing to put in a complete plant, including arc, incandescent and power services, to be paid for out of public funds, for the purpose of competing with and destroying the Barrie Company, a private and lawful enterprise.

In the course of the discussion S. Noxon, Ingersoll, expressed his sympathy with the work of the committee and said he believed there was an Act in Scotland providing against municipal confiscation. British law has wisely been taken as a precedent, and it might be so taken now. An electric light plant needed protection in this respect more than a waterworks plant, for the latter was of a permanent kind, while an electric light plant was subject to frequent change from the constant improvement going on, and a plant that is considered efficient now might soon become obsolete. In certain circumstances this might be an argument against us, but in other cases, as for instance, that at Barrie, where the municipality refused to treat at all, the cancellation of existing rights would be a double injustice to private ownership. E. D. Ellis, Barrie, referring to the case of his company, said they had been for two years without a contract with the town. The town authorities would not talk to them at all. His company wrote that they were anxious to be on a proper footing and would even sell out their plant at its proper value. The town told them to put in a tender along with other tenders they were calling for, which was not fair to the company, who protested that this was not fair, and offered to leave it to three competent men as arbitrators. The town would not arbitrate. Other towns were evidently watching the result of this case.

The president said he had followed this subject closely for some years and his experience had been that most people are anxious to reap where others have sown. The first bill provided against this in a way, but the committee were impressed with the conviction that these difficulties have to be openly discussed and fairly met. The committee did not feel inclined to go on with the bill that session but were urged on from various quarters, and a short bill was prepared with the idea of a larger measure in the future. The Hon. Mr. Hardy said he had no doubt that municipalities in the future would submit to arbitration. J. J. Wright, Toronto, said the strongest emphasis should be laid upon the point of arbitration. When a plant is purchased by arbitration it should be at its value, and it is worth as much to the municipality as to the private corporation. The separation of the public lighting from the private and commercial branches would mean ruin in many cases. He could not understand why the electric light industry should be singled out for so many attacks. There seems to be an exasperating glamor about electricity, probably owing to the superstition that there is lots of money in it. The chairman said people in small towns have a notion that a dynamo set up beside a water wheel will produce power for nothing. Mr. Wright—That is what they think in Toronto. Mr. Noxon thought the supply men were frequently to blame for encouraging municipalities in this course. Mr. Wright thought more harm was done by "half baked" dynamo tenders who pose as electricians than by the supply men. B. F. Reesor, Lindsay, said the Municipal Act of Ontario clearly stated that where a bonus is given to a town it shall not interfere with any existing interests, and he believed that taking this as a principle of law, if a test case were made where a municipality attempted to crowd out a private company without arbitration, the highest courts would affirm the company's rights, even without a special act. The chairman said lighting companies do not get bonuses and free sites like many other industries, and that is one of the hardships of the situation. A. A. Wright, Renfrew, said it was a difficult subject. There were political enemies as well as electrical enemies. An eye should be kept on the electrical supply men, who by telling half the truth to municipal authorities do incalculable harm.

This led to a tilt between the electric supply men and other speakers in which the former said they were "out for business" just the same as the electric lighting men, and it sometimes naturally happens that they cross each others paths.

The following standing committees were then appointed:

Statistics.—J. A. Kammerer, Toronto; A. A. Wright, Renfrew; S. J. Parker, Owen Sound.

Meter Inspection.—A. A. Dion, Ottawa; E. E. Cary, St. Catharines; J. J. Wright, Toronto.

Legislation Committee.—John Yule, Guelph; C. B. Hunt, London; B. F. Reesor, Lindsay; J. J. Wright, Toronto; W. H. Comstock, Brockville; F. Pepler, Barrie; A. L. Breithaupt, Berlin; C. Berkeley Powell, Ottawa.

NEXT PLACE OF MEETING—HAMILTON.

A letter was read from the Cataract Power Company, of Hamilton, extending an invitation to the association to hold its next meeting there. This was heartily endorsed by several members from Hamilton, and on putting it to the meeting the invitation was unanimously accepted.

J. J. Wright proposed, seconded by B. F. Reesor, that the remuneration of the secretary be $125 per year.—Carried.

Geo. H. Hill, Montreal, drew attention to the need of proper inspection of electrical construction, and thought that the Fire Underwriters should provide a competent inspector. At present there was no uniformity in inspecting, and in Montreal electrical men never knew where they were. During the discussion Mr. Browne, of the Royal Electric Co., said his company had already solicited the Government to appoint a competent inspector, but so far without success, and the company had to formulate rules of its own, which were generally accepted. Ald. G. W. Sadler said the City Council were now codifying general rules for building, plumbing, etc., and he would be happy to co-operate with a committee of this association with a view to having a set of rules for electric wiring and fixtures incorporated in these new rules.

On motion of Mr. Wright, Toronto, a committee consisting of A. A. Dion, Ottawa; F. H. Badger, jr., Quebec; P. G. Gossler, Montreal, and Ald. G. W. Sadler, Montreal, was appointed to meet the Boards of Fire Underwriters, and deal with the question.

Dr. J. K. Johnstone, Inspector of Electric Lights, Toronto, then read a paper, entitled "Experiences of an Inspector," which was well received.

EXPERIENCES OF AN INSPECTOR.

BY J. K. JOHNSTONE, INSPECTOR OF ELECTRIC LIGHTS, TORONTO.

When honored by an invitation from the Executive to prepare a paper for the society, I was somewhat in doubt as to the choice of a subject. I wished to furnish something that might be of interest to you and at the same time to avoid any of the important branches of electrical science which might leave me liable to criticism from gentlemen so highly qualified; hence, with your kind permission, I will confine myself to giving you a few impressions as received in my capacity as inspector.

At the introduction of the government inspection of electric lighting, there were a few, as you may remember, opposed to the act, and I acknowledge that it was with some misgivings that I went forth on my duties. However, it is with pleasure that I can now recall every visit made to the electric light stations in my district, and in every instance have I not only been kindly received, but every suggestion of improvement offered by me has been acted upon immediately and with evident pleasure. I need not tell you that in not one instance have I found any attempt on the part of electric light companies to defraud their customers, although occasionally appealed to by consumers on that ground. An investigation usually resulted in discovering old lamps, too few lights for the space lit, wastefulness where a meter was in use, or some other fault in the power of the consumer to correct.

The persistence of many purchasers of electric light in clinging to old and useless lamps is a common source of annoyance to the companies and a difficult matter to overcome. The old lamp is often expected to give as brilliant a light as when first installed, and when unable to do so the charge is frequently made that the company supply a too low voltage. To please these grumblers, a mistake is sometimes made in endeavoring to supply a current sufficient to brighten these worn-out lamps, and this, too, at the expense of new lamps, whose brilliancy is thus deteriorated. As it is impossible to compel the purchase of new lamps, and as the companies are anxious to please their customers, I have suggested, when consulted, that new lamps should be supplied at their actual cost, thus throwing the blame on the consumers when their lights were poor, economising electric current and sparing new lamps.

The question as to the advisability of using meters, where practicable, can only be answered in their favor. By the employment of a meter a just system is accorded to manufacturer and consumer alike; the wasteful man is made to pay fairly for his neglect, while the careful and honest man is charged only for the light needed and current consumed. Under the flat rate system, it is not uncommon to see large shops brilliantly illuminated throughout the entire night. Managers tell me that it is difficult to introduce the meter where flat rates have been charged, but, despite the objections, many are making the change. The several types of dial registering meters which I have inspected are usually accurate, and I am told prove satisfactory as measuring instruments for either power or light.

A lack of uniformity in rates, both by meter and flat rate systems, has been a subject of complaint with some managers. There is evidently no remedy for this unless an arrangement can be arrived at by the manufacturers themselves and a standard charge agreed to.

In several towns in the district visited by me, a system of street lighting by incandescent lamps has been adopted. When properly arranged the appearance is quite pretty and the light well distributed.

In concluding, permit me to tell you that the managers and electricians I have met in my work are, without exception, kindly and intelligent men, and in this favorable opinion I am borne out by other inspectors with whom I have spoken upon the subject. It has been suggested to me that there may be some potent and subtle charm in the electric current which develops the best qualities in a man's character. Can this be so?

W. T. Bonner, Montreal, read his paper on the "Quimby Screw Pump," which has been crowded out of this issue.

Mr. Bowman's paper on "Methods of Illumination" was taken as read, and the paper promised by Mr. Hopkins on electricity in Rainy River was not received.

The afternoon was devoted to social features. The first event was the inspection of the Bell Telephone Co.'s new building, where L. B. Macfarlane, the genial general superintendent, had a staff of the company's employees, who took charge of the visitors in groups and explained the wonderful complexities of the great exchange room, one of the largest and most perfect telephone exchanges in the world. After this the Montreal Street Railway Co., which had provided special cars to bring them down here, conveyed the visitors to the company's great power house, where 8,000 horse-power was observed in operation, the new 4,000 h.p. engine—the largest in Canada—being particularly admired. Four big pleasure vans were in waiting for the company at the corner of McCord and Seminary streets, the distribution station of the Lachine Rapids Hydraulic and Land Company, and after inspecting this building the party were driven to the big power house at Lachine Rapids along the picturesque Lower Lachine Road. Dismounting here the visitors were first shown the sea of rapids that tumbled and roared beyond the embankment at the outer end of the power house, and then they were shown the long gallery of turbines, and four large generators in operation. These generators, which were built by the Canadian General Electric Co., have previously been described in The Canadian Engineer in connection with an account of the Lachine Company's works. The inspection over, the visitors were invited to a cold collation and liquid refreshments which were enjoyed very much. Senator Thibaudeau, president of the Royal Electric Co., in a few graceful words, conveyed the thanks of the association to the company and said of Mr. Walbank, the general manager, that the longer he had known him the more he esteemed his genial qualities, and he trusted he would be rewarded with all the success his enterprise and foresight merited. Mr. Walbank, replying, thanked the honorable senator for the compliment paid him, which he valued the more coming as it did from the head of a rival company. [Senator Thibaudeau.—Say "elder sister."—Laughter.] Mr Walbank took occasion to correct a member who on the previous day, speaking of unremunerative schemes that supplied more power than was demanded, said this company had only two generators running and not paying. As a matter of fact there was only one generator at present running during the day when lights were not in use, but at night there were three dynamos running, and the company was quite satisfied with the prospects. The visit closed with three cheers for Mr. Walbank, and the visitors were driven to the head of the dam, where they arrived just in time to see the steamer Sovereign run the rapids. The party returned to the city by way of the "Glen" and Dorchester street, and were set down at the Windsor thoroughly pleased with the excursion. The refreshments and conveyances were supplied jointly by the Canadian General Electric Co., and the Lachine Rapids Co.

THE BANQUET.

The annual dinner, which took place at the Windsor on Wednesday evening, 29th, will be remembered as the most successful in the history of the association. President Yule made an excellent chairman and kept the business of the evening moving without any tedious hitches. The dinner itself did credit to the Windsor's well-known reputation. The cover of the programme had the association's monogram and maple leaf in gold, and the covers with menu and toast list were held together by covered copper wire. The menu was as follows:

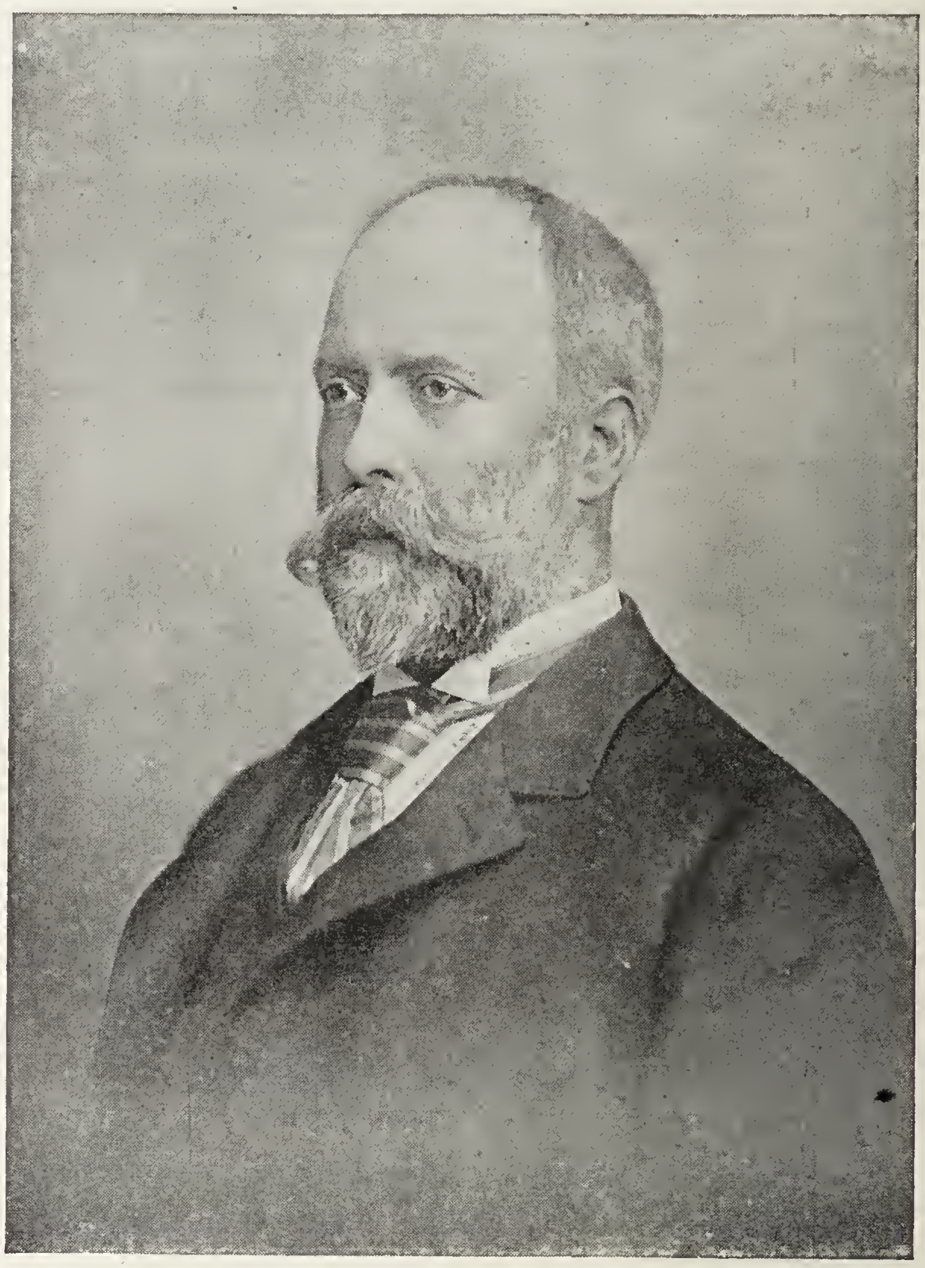
MENU.

Long Distance Transmission.
Fire Island Cocktail—50,000 Volts.
Internal Resistance.
Cucumbers Radishes
Tomatoes, strain Insulators. Olives tripled Braided Electric Juice.
Green Turtle, a la Water Rheostat,
Cream of Asparagus, a la Ozone.
Submarine.
Saguenay Salmon, a la Hello, Potatoes, Rachel.
Shunts.
Spring Lamb Cotelettes, Sweet Breads,
Carbon Trimmed,
Asparagus—"Arrester" Points.
Joints—"Soldered and Taped." Filets of Beef, Larded
Relays and Sounders, String Beans,
Boiled New Potatoes, Anchors,
Cauliflower, Asparagus, Sweet Peas.
Trolley off. Punch au Champagne.
Reconstruction.
Roast Philadelphia Capon, Plants, Lettuce and Tomato Salad.
Boosters.
Cabinet Pudding "sound proof."
Gelee aux Oranges, "insulating compound."
Savarin aux Ananas, "vacuum light,"
Vanilla Ice Cream, "self cooler."
Sponge Cakes, "Leather Belting."
Dessert.
Fruits, "potential currents," Nuts and "wrenches,"
Electric heater, Incandescence
Cafe Noir, Cigars.
Transfer. Ring off. Open Circuit. "30."

On the chairman's right sat Mayor Prefontaine, Ald. Sadler, Dr. W. H. Drummond, C. B. Powell, and on his left the Hon. Senator Thibaudeau, W. R. McLaughlin, L. B. McFarlane, D. A. Macdonald, W. H. Browne, C. B. Hunt and P. W. St. George. The others present were: J. A. Kammerer, Toronto; John Carroll, Montreal; Samuel Adams Chase, New York; P. G. Gossler, L. D. W. Magie, Wm. T. Bonner, W. E. Quimby, F. W. Fairman, J. C. McCormick, R. H. Bartholomew, Wm. Smyth and John J. York, Montreal; A. A. Wright, Renfrew, Ont.; C. H. Wright, Alex. Barrie, William B. Shaw and D. W. McLaren, Montreal; Andrew Sangster, Sherbrooke; Geo. C. Rough, T. W. Atkinson, H. J. Gardiner, R. Dobie, H. J. Fuller, James A. Baylis, P. H. Hart, Fred. S. Hickey and James H. Campbell, Montreal; A. M. Wickens, Toronto; J. F. H. Wyse, Brantford; V. B. Coleman, Port Hope; E. J. Kyle, Kingston; H. A. Moore, Trenton; J. W. Campbell, J. S. M. Ridley and E. D. McCormack, Toronto; J. W. Pilcher, Montreal; M. B. Lovell, Coaticook; H. E. Allen, Waterloo, Que.; H. E. Channell, Stanstead; Chas. E. Taylor, Montreal; E. Craig, Montreal; Gordon J. Henderson, Hamilton; A. W. Staveley, P. H. Davidson and J. R. Meadcroft, Montreal; A. L. Breithaupt, Berlin, Ont.; J. K. Johnstone, and J. J. Ashworth, Toronto; W. F. Dean, Thomas Rodger, D. S. Barton, Jas. Hunter, Charles D. Matthews, and H. C. Ross, Montreal; George D. Ellis, Barrie; W. Ahearn, jr., W. G. Bradley and Ed. J. O'Reilly, Ottawa; J. W. Martin, Hamilton; H. W. McLaren, Montreal; E. B. Biggar, J. J. Wright and A. B. Smith, Toronto; Fred Thompson, Montreal; Wm. McCaffrey and Walker G. Anderson, Toronto; J. W. Purcell, Walkerville; C. E. A. Carr, London, Ont.; C. L. Weeks, Toronto; J. R. Wilkes, J. E. Scott and James Kent, Montreal; D. A. Starr, Cornwall; Wm. Campbell, Montreal; C. Thomson, Ottawa; S. Noxon, Ingersoll; P. Morgan, B. F. Reesor, Thos. Sadler and D. McGibbon, Lindsay; G. A. Powell, St. Catharines; R. E. T. Pringle and F. H. Leonard, jr., Montreal; E. E. Cary, St. Catharines; M. P. Cochrane and W. E. Gower, Montreal; Geo. H. Hill, L. Rousseau, Montreal; W. R. Leet, Danville; C. H. Mortimer, Toronto; Henry B. Haigh, New York; L. Robinson and John T. Murphy, Montreal; Robt. Welsford, England; W. F. Simms, Kingston; R. Stanton Wright, Ernest J. Jenking and M. Rubenstein, Montreal; Geo. Black, Hamilton; W. F. McLaren, R. F. Morkill, W. J. Plews, L. A. Howland, J. Fleet and J. W. Morris, Montreal; F. A. Wunder, New York; J. A. Burns, Geo. E. Matthews and Edward Carter, Montreal; W. A. Johnson, Toronto; E. A. Wallberg and R. A. Ross, Montreal; H. G. McLaren, London, Eng.

After "the Queen" had been loyally drunk, the secretary read several letters of regret from absent friends and members, among which was one from F. C. Armstrong, who was then on his way to England, but who desired to assure the company that his thoughts would be with them this evening. Mr. Browne departed from the programme for a moment to propose the health of Mr. Armstrong and wish him prosperity in his new and important field of work, and the rousing enthusiasm with which the toast was received showed how many warm friends Mr. Armstrong had around these tables. "He's a Jolly Good Fellow," was at no time more heartily sung. The chairman then proposed "Electrical Montreal," and coupled with it the name of Mayor Prefontaine, who, he said, ought to be made an honorary member of this association, as His Worship was the projector and proprietor of an electric plant at Ste. Agathe.

The mayor, who was received with hearty enthusiasm, said he would have hesitated somewhat at responding to what was really the toast of the evening had it not been that to some extent he was connected with the electric service. The importance of electricity among the sciences was apparent to all, and it was gratifying to him that so many French names, such for instance, as Ampere, were written in the history of that science. Referring more particularly to Montreal he ventured to say that this city with its population of over 300,000, including suburbs, had made a record that would compare with any city in the world. The pioneer company in Montreal was the Royal Electric Company, which began in 1884 with a dynamo of 12 arc lights capacity and a dozen employees, with a capital of less than $50,000. To-day this company was serving from its two generating stations electric current for 1,500 arc lights, 75,000 incandescent lights, besides 2,000 h.p. in motors. Its new factory has an area of 40,000 square feet, it has over 5,000 employees, and a capital of $2,500,000. In July, 1886, the city gave an order for 133 arc lights for street lighting, which was considered a big contract then, but to-day the city has nearly 1,500 arc lights. One of the latest contracts of the Royal Electric Company is to supply current to the Dominion Cotton Mills Co., to the extent of 1,500 h.p. to operate their large cotton mills in Montreal. The Chambly Manufacturing Company, by which current will be transmitted from the Richelieu River to Montreal by September next, represents a development of 20,000 h.p. He was one of the original promoters of this company, having got its charter through the legislature, and so foolish was the scheme considered that his action in the matter was put down to a desire to win a few votes at the next election. But now this great power is practically ready for transmission. Another enterprise which was a credit to Montreal was the Lachine Hydraulic Works; with a capital of nearly $2,500,000, which has harnessed the St. Lawrence. The enterprise was a vast one. It might not be the complete success at the present time which its promoters expected, but that it would ultimately be a success no one doubted; and it would be a credit not only to the city, but to the gentlemen who had carried out such a big enterprise. In 1892 the Street Railway began operations by electric power, which was first generated at the power house of the Royal Electric Company, with two dynamos of about 500 horse-power; to-day it had 80 miles of track and a plant of about 10,000 horse-power, including an engine built by the Laurie Engine Company, of about 4,000 h.p., one of the largest steam engines in use. In 1894 the Montreal Park & Island Railway Company began operations, and to-day it was running to Back River, St. Laurent, Outremont, Cartierville, etc., and was operating about sixty cars. There were about 8,000 telephones in use in the city, exclusive of about 1,200 belonging to the Merchants' Telephone Company, so that the progress of electrical science in Montreal could easily be seen. He concluded by congratulating the association on the good work it was doing, and said he wished to become a member. The mayor was given three rousing cheers. J. R. Wilkes here sang "The Clang of the Forge," and was heartily encored. The toast of "Our Association" was followed by two comic songs from F. S. Hickey, who made himself a favorite at once. "Sister Associations" followed and R. H. Bartholomew sang "The Anchor's Weighed," and in reply to a hearty encore sang "Maid of Athens." "Our Guests" was replied to by Hon. Senator Thibaudeau, who in acknowledging the honor done him, said, the gentlemen he saw around were the representatives of what was most distinguished in the electrical world. It was to them that Canada owed its great strides in putting into operation the electrical force which had transformed all around us; it was to their energy that everything had been metamorphosed in the Dominion; it was to their accumulation of science that we had to-day those conveniences which contributed to the happiness of this nineteenth century, such as electric tramways, electrical power apparatus, telephones, the lighting so good and so brilliant that one could almost see his conscience better than he could with the "X" rays of the Christian teaching. Montreal had felt the magnetic impulse. The Lachine Hydraulic Works, which they had seen that afternoon in their grandeur, and the Chambly Works, which they would visit the next day, would tell them more about electrical progress in Montreal than he could. These works would tell them that the electricians of Montreal well deserved to be members of their association, and were a credit both to the association, and to the city of Montreal. The electricians of Montreal were jolly good fellows; they might ground a wire now and then, but they were seldom grounded themselves. (Laughter and applause). They also had their periods of incandescence, but it was with a good motive. In conclusion, he wished the Canadian Electrical Association and its members every success. Dr. Drummond was then called upon and gave the habitant's description of summer from his well-known book "The Habitant." At its conclusion there were clamorous calls for the "Pap'neau Gun" which was recited with fine effect. E. I. Jenking then gave a song, which was encored. The president proposed "Electrical Research," and coupled the toast with the name of W. H. Browne, who was not "general manager" to-night, but "one of the boys." Mr. Browne, who was received with "He's a Jolly Good Fellow," regretted the absence of Prof. Herdt, the able scientist of McGill, who was to have replied to the toast, but who was kept away by the serious illness of his wife. Disclaiming any pretensions to science himself he nevertheless spoke entertainingly of the advance of electricity within the past few years. It was only ten years ago that the first electric railway—a pioneer enterprise with which he was connected—began operations, while to-day there were 80 miles of track in this city alone. When hotels were being fitted up with electric curling irons in each room for the lady guests, what developments might we not expect in the near future. The farmer who now could grind his corn, chop his fodder, etc., by electricity, might soon be able to milk his cows electrically. Some one suggested that the day would come when we should eat, sleep, walk and talk electrically and man would thus become an automaton governed entirely by electricity —but, of course, we wished to defer that day as long as we could. (Laughter.) Messrs. Campbell and Starr then gave a duet which was well received and encored. "Allied Interests" was responded to by Ald. G. W. Sadler, of Sadler & Howarth, Montreal; E. E. Cary, of the Packard Electric Co., St. Catharines; C. Lord Weeks, Toronto, and Duncan Macdonald, superintendent of the Montreal Street Railway. Mr. Sadler referred to the fears of some manufacturers that their business would be wiped out when electricity came into general use, but to-day these lines of business are not only thriving but new lines have been created, due to electrical development. He referred to the first electrical exhibition in Montreal, and suggested that exhibitions should be held in connection with future conventions. Mr. Weeks entertained the company with some humorisms, and Mr. Cary, who followed, showed how the evolution of electrical work in Canada had opened a field for specialists in manufacturing, and their success had shown that the progress of the country was steady and rapid. The three years he had spent in Canada were the happiest of the fourteen years in which he had been engaged in electrical work. Mr. Macdonald humorously sketched the difficulties of a street railway company. If anything goes wrong in the city the street railway is blamed. If the cars go too slow it is their fault, if they go too fast it is their fault all the same. Speaking of the progress of electricity he believed it would continue and perhaps be surpassed by the rising "generators." If our nearest ancestors could return from their graves and view the improvements and enjoy the blessings brought about by this science they would be astounded, and would lavish praise upon the electricians. In fact they can be called the Deweys of this generation. If the association returned with its convention to Montreal it would be greeted with a thousand welcomes. Mr. Kammerer was then called on and amused "the boys" with a funny story, after which Mr. Wilkes sang "Loch Lomond." "The Press" and the "Ladies" concluded the evening, the latter being replied to by Dr. Drummond, who recited the heroic episode of Madelaine Vercheres. The company separated at 1.30 a. m.



WM. H. BROWNE, PRESIDENT CANADIAN ELECTRICAL ASSOCIATION.

THURSDAY, JUNE 30TH.

The first business of the morning was the election of officers, all except the new members of the Executive being returned by acclamation. Mr. Hunt was nominated for president but declined to stand. The result was as follows:

President—W. H. Browne, general manager Royal Electric Co., Montreal.

First Vice-President—H. P. Dwight, president and general manager Great North-Western Telegraph Company, Toronto.

Second Vice-President—A. A. Dion, Ottawa Electric Co., Ottawa.

Secretary-Treasurer—C. H. Mortimer, Toronto.

Committee—J. J. Wright, Toronto; John Carroll, Montreal; O. Higman, Ottawa; A. B. Smith, Toronto; Wm. Thompson, Montreal; W. McLea Walbank, Montreal; E. E. Cary, St. Catharines; Gordon J. Henderson, Hamilton; H. R. Leyden, Hamilton; George Black, Hamilton.

On moving the new president into the chair the thanks of the association were tendered to ex-President Yule, whose urbanity, tireless industry and sound common sense had done so much to advance the association in public estimation during the two years in which he had held office. A hearty vote of thanks was also passed to the members of the local committee and to the various companies who had shown their hospitality on such a munificent scale. The members then went to visit the electrical and mechanical departments of McGill University, where the numerous electrical machines and delicately adjusted instruments were explained by Prof. Herdt with a lucidity that greatly impressed the visitors. The inspection was concluded by a visit to the physics buildings, where an interesting demonstration of X-rays phenomena was given by Mr. King.

The afternoon was taken up with a visit to the extensive works of the Royal Electric Co., where among a multitude of other work in process of manufacture the visitors saw parts of the big generator now being made for the Cataract Power Co., of Hamilton. From here the company went to Bonaventure station where a special G. T. R. train of four cars was in waiting to take them to Chambly, to see the works of the Chambly Manufacturing Company. Anticipating a large excursion the Chambly Manufacturing Company had requisitioned every vehicle in the town to convey the party from the station to the works. There were cabs and calashes, cabriolets and broughams, grocery wagons and butcher carts, market wagons and buckboards, in all conditions of repair and with all conceivable styles of upholstery. The cavalcade was greeted with cheers and the attack on Santiago was nothing to the storming of these vehicles. The scenery of the quaint old village of Chambly was much enjoyed, and so was the visit to the great dam and power house which have both been described in recent numbers of The Canadian Engineer. The venerable but still active president of the company, S. T. Willett, who has been elected mayor of Chambly continuously since 1873, was present to welcome the visitors, and did it with the sincerity so characteristic of him. After being photographed in a group the visitors were called into the upper story of the power house and beheld a table of interminable length spread with immense dishes of cold meats, confectionery, strawberries and cream, lemonade, claret cups, etc. To say that "full justice" was done to these provisions would be putting it mildly. Mr. Willett, who occupied the chair, welcomed the members and their ladies, and credited the electrical science with the transformation which was now being made in the town and its prospects. Hon. Senator Thibaudeau made a short speech of welcome which was well received, especially by the ladies whom he complimented with a gallantry so natural to a French Canadian. Mr. Browne followed with a few words of welcome on behalf of the Royal Electric Co., referring to the fact that beneath their feet the Chambly Co. had harnessed 20,000 h.p. where the shallows of a river had been running to waste for ages past. On behalf of the association Mr. Dion thanked the company for the handsome entertainment and excursion, which the members enjoyed, and the party returned to the city delighted with their trip, which formed such a pleasant finale to the convention.

A. A. Dion, 2nd vice-president Canadian Electrical Association, was born and educated in the city of Quebec. He commenced his electrical career in the service of the old Dominion Telegraph Co., in 1876. After filling various positions and engaging in railway work for a few years, he was appointed electrician for the Intercolonial Railway system of Canada in 1889. He resigned in 1891 to take the superintendency of the Chaudiere Electric Light & Power Co., of Ottawa, a position which he filled until 1894, when the amalgamation of the three lighting companies doing business in Ottawa took place, when he was made general superintendent of the amalgamated companies known as the Ottawa Electric Company, which position he now holds. Mr. Dion was a member of the Executive Committee of the Canadian Electrical Association for 1897-98. He is a member of the American Institute of Electrical Engineers.

A. A. DION.

CONVENTION NOTES.

Taken as a whole the convention was the most successful in the history of the association. About 50 new members were elected, chiefly from Montreal and vicinity, and these were not drummed up, but were men who came in from a natural interest in the work of the association.

Secretary Mortimer had a good deal of work to do and got through it very creditably. Mr. Mortimer has one good quality among others, and that is he never fails in civility and courtesy.

The Packard Electric Co., of St. Catharines, kept open house at rooms 11 and 12 in the Windsor, and all were made royally welcome. Their Montreal branch was illuminated and the crowd of conventioners gave three cheers when they passed the place on one of their city trips.

Ald. Sadler's suggestion of an exhibition of electrical machinery in connection with the next convention was a good one, and is worth early discussion. The Packard Electric Co. made a little start on its own account by showing the sections of their new transformer and other goods in their rooms.

Mr. Kammerer gave the members a pretty souvenir in the shape of a little silk bow formed of the Union Jack on one side and the Stars and Stripes on the other. In bestowing it Mr. Kammerer did not forget the ladies. He never does.

"These gentlemen," said The Witness in one of its notes, "are adepts at 'stringing wires,' but it is pleasing to note that they do not—at least at association meetings—go in for 'pulling wires,' for official positions are filled with a view to the advantage of the association.

Among the American visitors was F. A. Wunder, of the New York office of the Fort Wayne Electric corporation. Mr. Wunder was pleased with what he saw in and around Montreal, and is generously leaving a memento of his visit in the shape of one of the company's Watt-hour meters, which will be presented to McGill University. Reference will be made to this in The Canadian Engineer. Besides Mr. Wunder, Mr. Quimby, the inventor of the Quimby screw pump, and Mr. McLaughlin, of The Electrical World, were present from over the border.

Too much praise cannot be given to the individuals who formed the Entertainment Committee and the companies who so liberally contributed their work and money to aid them. It is only another good illustration of the saying that when Montreal men undertake a thing of this kind they do it well.

The Canadian General Electric Co. had what the boys called a very "nifty" idea in the form of a nickel-plated model of a C. G. E. motor to be used as a paper-weight. It was much appreciated by members as a souvenir.

Among the many attractive points in Montreal during the convention, that of John Murphy & Co.'s store, where John Forman made an exhibit of the Upton Midget Enclosed Arc Lamps, held the attention of the delegates probably as much as anything they had seen. This shop has lately had installed a large number of these lamps, having discarded their old style of arc lighting, and in some places done away with the Auer Incandescent Gas Light, and arranged to have the whole establishment lit with the Upton Midget Enclosed Arc Lamp. After a very careful test of the various lamps of different manufacture in the market, they concluded that the Upton was by far the most economical system of lighting to be had. This store, which is situated on St. Catharine street, (Montreal's principal thoroughfare), has fitted in the fourteen large windows fourteen of the Upton lamps, each arranged with a special bell mouthed shade, and though these lamps are taking but 4½ amperes on 100-volt circuit, the illumination far surpasses some of the window lighting on the same street where ten and fifteen incandescent lamps are used in handsome reflectors on 52 volt circuit, where each lamp would be drawing 1 ampere. In the case of the incandescent, 15 lamps would be drawing 15 amperes of current and giving 240 candle-power, while with one-third of the amount of current on the Upton Midget, the latter were giving 800 candle power, or practically three times as much. Not the least important point in this installation was the fact that the lamps which were ordered from John Forman, 644 Craig street, Montreal, on Wednesday the 22nd, were ordered on from the States, while handsome fixtures were being manufactured in Montreal for the installation, and the whole was in satisfactory working condition on Monday the 27th.

LAUNCH OF THE TORONTO.

Every circumstance favored the ceremony of launching the new Richelieu & Ontario Navigation Co.'s steamer "Toronto," which took place from the shipyards of the Bertram Engine Works Co., on the afternoon of June 21st. A clear, bright day, with a westerly breeze, brought out dozens of sailing craft and row boats, as well as some steam yachts, to view the first floating of the finest steamer ever built in Toronto. The decks of the steamer "White Star" were crowded with citizens who had come at the invitation of the Bertram Co., to view the launching, and about four o'clock the steamer lay to at the inner end of the Eastern Gap, opposite the shipyard where the new vessel stood braced up from stem to stern as if conscious of the impending event and eager to make the plunge. The supports having been knocked away, Madame Forget, wife of Senator Forget, president of the R. & O. Nav. Co., broke a bottle of wine on the bows of the new boat, christening her the "Toronto." A. Angstrom, constructing engineer and designer of the boat gave the command "let go," and when the last block was knocked away the handsome vessel, gay with flags and streamers, slipped gracefully down the ways, dropped into the water with a lurch that sent the spray into the air in a vast cloud, and then she bounded upward "as a steed that knows his rider," shaking the water from her decks like a duck and then settled with a buoyant air on her native element. The large crowd upon the docks and on the steamers and boats set up a cheer at the neatness of the performance and the pretty outlines of the boat, while the band on the "White Star" played "Britannia Rules the Waves." The "White Star" then drew off into the bay, where congratulatory speeches were delivered, J. K. Osborne, one of the western directors of the Richelieu Co., presiding. Among the speakers were Sir Oliver Mowat, Senator Forget, Col. Henshaw, Mayor Shaw and Geo. H. Bertram, M. P. C. F. Gildersleeve, the general manager of the Richelieu Co., was present at the function. The company was entertained at a champagne luncheon by Mr. Bertram.

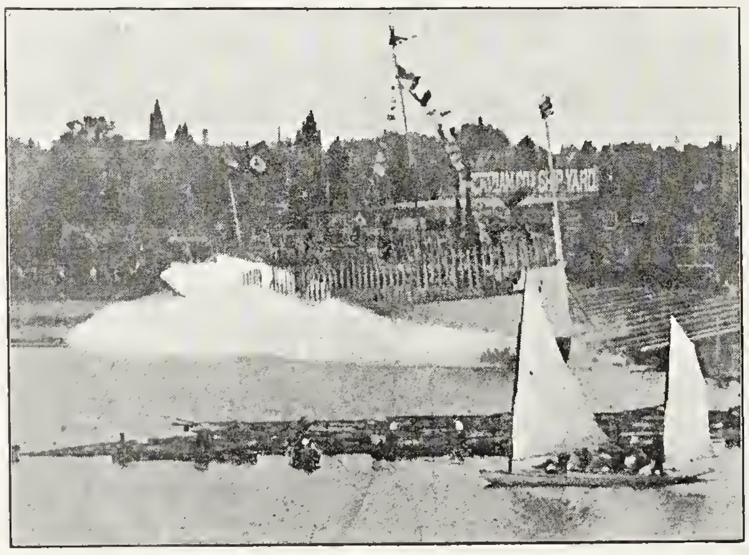


Photo by N. T. Maclaurin, amateur.

THE "TORONTO."

The new steamer, which will probably be ready for "sea" some time in September, will cost $240,000 exclusive of furniture and fittings, or about $275,000 in all, is guaranteed to make an average speed of 17 miles per hour on regular trips, but her estimated power will give 20 miles per hour when pushed. The following is a brief description of her:

The hull, constructed of open hearth steel, and of the following dimensions: Length over-all, 278 feet; length keel, 270 feet; beam, moulded, 36 feet; beam, over-guards, 62 feet; depth, moulded, 14 feet. The engines are of the triple expansion, inclined jet condensing type; cylinders, 28, 44 and 74 inches by 72 inch stroke. The feathering paddle wheels are 22 feet outside diameter, and 10 feet 3 inch face of bucket. The air and feed pumps are attached to and worked from main engine. The boilers are four in number and are of the return tubular type, 11 feet diameter, and 11 feet 6 inches long over heads. Each boiler has two 41½ inch outside diameter Monsom suspension furnaces. The boilers are fitted with the Howden Hot Draft, and are designed for a working pressure of 176 pounds. Spacious and elegant passenger accommodations are provided, one hundred and forty staterooms, including four parlor rooms and large Pullman sleeping cabin, furnish sleeping accommodation for 430 passengers. The dining room, placed on the upper deck, has a seating capacity for over a hundred persons. The interior finish and decorations of the spacious halls and deck saloons, are most elaborately executed, the main and gallery saloons being finished in Francis I. Renaissance style, with the dining rooms in Louis XVI. The entrance hall is decorated in Neo Grec, with modern Renaissance details, with the smoking room in Oriental treatment. The refreshment and writing rooms will be in Elizabethan panelling of prima-vera, natural wood finish. The main staircases are Honduras mahogany, with wrought metal balustrades, in hammered leaf work, finished in antique bronze, the main newels carrying bronze figures supporting electric torches. A 700-light electric light plant, with ornamental electroliers, in cabins furnishes light throughout the steamer.

ROPE DRIVING.

The subject of rope driving has so far received little or no attention at the hands of our Canadian engineering journals, in fact, we may safely say, that even in the United States, this is a subject touched upon very sparingly by the trade papers and mechanical publications generally. We fancy the reason of this is that rope driving is a branch of mechanics not so generally taken up by the ordinary run of engineers and machinists, but is as yet more of a specialty, and has so far only been advocated strongly or to any extent by one Canadian firm, the Dodge Company, of Toronto. We believe that rope driving has a field of its own, and is not necessarily a competitor of the belt manufacturers as has been supposed. We have called at the office of the Dodge Co., Toronto, and have learned the particulars of a very interesting piece of work recently completed at the works of the Globe File Mfg. Co., Port Hope, Ont., by the Dodge Co., Toronto. In this instance the power of three 40" Leffel water wheels, under a 12' lead, had been transmitted to the line shafts in shops, by means of bevel gears and crown wheels, on ends of upright shafts from water wheels—power taken from each wheel being about 40 h.p. In one case there were used a pair of bevel gears to carry the power of one of the wheels to a shaft at right angles to the others. In all three upright shafts there was a continual trouble in keeping them in line, owing to the great strain on their upper end, also in the case of the geared shaft at right angles, there was a continual jam either against the boxes, or the pinion on crown gears, thus consuming too large a percentage of the power. The crown wheel on No. 1 shaft had to be re-toothed as often as every two weeks, on No. 3 shaft every three months, and on No. 2 shaft two or three times a year, so that on the whole the power was unsteady, and much time was lost in re-toothing wheels and keeping them in proper alignment. In addition to this the noise from the gears was deafening, and the dirt from oil dropping, etc., created a nuisance. With a view of a remedy the Globe File Co. therefore consulted the Dodge Co., and after the latter company's engineer had made a thorough inspection of the plant, a plan was devised to dispose of all the gears, and to transmit the power of the three wheels to the different line shafts by a system of rope transmission. The Dodge Co.'s men made the change and started up under the new rig without a hitch.

As to how the change has suited the Globe File Co., the Dodge Co. has shown us a copy of a letter recently received by them from F. Outram, the manager, he says: "As regards the three rope drivers you put in for us, they are working to our entire satisfaction. We know we are saving considerable power, besides doing away with the noise and rattle and wearing out of wood and iron gears—and it is ever so much cleaner. We would not change back for five times what the change cost us."

Yours truly,
Globe File Mfg. Co.

This letter goes to show that there are many instances to which the rope drive is particularly suited.

There are two systems of rope driving, i.e., what is known as the "American" or single continuous rope with an automatic take up or tightener, and the "English" system, which is a series of independent ropes. The former is the system advocated by the Dodge Co. We understand that some of our largest plants in Canada are run altogether by ropes, and they are found to be economical. The E. B. Eddy Co., of Hull, Quebec, is a great believer in the rope drive, and has several thousand horse power in daily use, installed by this company.

For THE CANADIAN ENGINEER.

FUTURE OF MECHANICAL TRACTION.

As to the future of the autocar industry, space does not permit of more than the briefest summary. The problem of transportation is the largest and most pressing in Canada to-day; whether we view the matter from the standpoint of convenience, speed, good roads or expenditure, the autocar looms up as a most important factor in the problem. Let us summarize a few facts.

The average cost of transport to-day of goods between Liverpool and Manchester, a distance of 35 miles, is over $2.25 per ton, the quantities to be conveyed being at least 15,000 tons per week. There are railways and there is the new and magnificent canal, and yet shippers demand a better and cheaper means of transport; for it must be remembered that although the rates must be high on account of the enormous capital account, both by water and rail, the carrying is not terminal, and three or four trans-shipments are involved in every bale of goods. By a light railway system, which would be inexpensive, compared with the ordinary railway and canal, motor wagons might utilize rails for the greater distance and run off the rail on to ordinary roads at the termini; the goods thus being handled only at each end when being loaded and unloaded, and a large item in the cost thereby saved. With all that can be done by railways or tramways, there are millions of tons of passengers and goods to be provided for between railway stations and destinations. Worby Beaumont, president of the Society of Engineers, points out that "it is not generally known that to-day it costs more to send a ton of goods by rail between some places in this country (England), than it cost formerly to send it by horse on the common roads. . . . The cost of haulage by rail is very small, but the terminal cost and cost of railway establishments, as vast machines, are so heavy, that the cheapness of railway transit disappears." He also points out that the British post office finds it cheaper to send its parcels by road than to pay the rates demanded by the railway companies for that traffic. When the comparatively small cost of autocar and motor wagon equipment for passenger and freight purposes is compared with the immense initial cost of railways, ordinary tramways, and canals, it will be seen that just as surely as the horse-cars have given place to the trolley, so surely must the heavy and expensive cars and rails, with the enormous funds required for maintenance, interest charges, etc., give way to the lighter, cheaper, and easily adaptable system of autocars.

In large cities, such as London, the question of space is another important factor. As Mr. Beaumont points out, there is such a density of traffic in London that nothing but the short-distance passenger accommodation must be allowed in the streets, either by tramcar or omnibus. "As early as possible," he says, "the motor cabs and omnibuses must displace horses so as to save the space now occupied by them, and avoid the pounding to pieces of the wood, asphalt and other of the best pavements with the 300-weight hammers of iron-shod horses' feet." He reckons that at least one-third of the space now occupied by the horses can be saved by the employment of motor vehicles. Some idea can be gathered of the pressure on London streets when it is remembered that every 24 hours

	Persons.		Vehicles.
Blackfriars Bridge discharges	69,838	and	8,287
London Bridge discharges	107,421	and	14,367

Then the cost of horses is in itself a very large item. Mr. Beaumont gives a calculation in which he shows that in Great Britain there are at present about 1,200,000 draught horses employed; but assuming that only 500,000 are at work, taking only the cost of keeping these horses, and saying nothing of the destruction to roads, the improvements in the roads which he recommends would result in a saving of £30 per year per horse, or a total of £5,100,000, which capitalized at three per cent. represents £170,000,000 sterling. He argues, "There is no doubt that such a sum might profitably be invested in the roads of Great Britain if we consider the advantages to be derived from mechanical traction."

The solution of the question of transport between towns does not necessarily lie in the direction of street railways or tramways, which Mr. Beaumont emphatically pronounces, "metallic admissions by engineers to the public of the badness of the ordinary roads." He adds that in the future of good roads, "Tram-rails in our streets will be considered nuisances not to be tolerated;" and "the days of toleration only wait for those mechanical road vehicles to prove plentiful as well as successful."

There is no reason, indeed, why the motor wagon enthusiasts should not carry their war into Africa, if they can only get engines with sufficient power; for the power directly applied to the driving wheels of autocars, and the immense tractive power of good roads, as compared with rails, put railcars at a disadvantage, when it comes to the cost of equipment and running. With 6,000 h.p. developed at the power house of a street railway company, the cars can only get what tractive effort the wheels will give them on the line. This is the weak link in the chain. In the case of a snow drift, for example, a motor car with spiked wheels would be able to overcome the obstacle better than the strongest street car plough. With the cars coupled up as they are to-day, the front car is never doing satisfactory work, because it is insulated by the snow, and therefore not getting power. Every few feet it has to be drawn out by the other cars. In the case of motor cars on the roads, they could not be insulated, and a set of three autocars, if hitched together, could be made to develop a total of 60 horse-power steadily applied, with a tractive pull of three tons.

Another element in the discussion of mechanical traction is that of danger to life and limb. In Britain the newspapers make "scare-heads" over every item in reference to accidents to motor carriages and their occupants, but never use the "deadly parallel" in showing the relative danger of motors and horses. In England and France there have been three deaths in connection with motor vehicles—all caused by recklessness and carelessness. The following record of accidents and deaths from horses in the vicinity of Toronto alone during two months is far more appalling:

Killed:—April 9th, Wm. J. Fenton, dentist, Toronto, horse frightened by watering-cart; 16th, Chas. Ralston, farmer, Walkerton, horse frightened by bicycle; 17th, Edward Lee, farmer, London; 19th, Isaac Ferris, St. Mary's, horse frightened by train; 23rd, Thos. Robinson, Omemee. May 1st, Joseph Bailey, farmer, Walkerton; 8th, Dalton McCarthy, M.P., Toronto, horse frightened by sound of church organ; 25th, Anthony Hurley, farmer, Eastwood, horses frightened by railway train. Total number killed in two months—8. Injured:—April 4th, son of David Hastings, Blenheim, badly injured; 16th, son of Chas. Ralston injured (father killed as above); May 1st, London omnibus party, several ladies hurt; same date son of Joseph Bailey injured (father killed as above). Total number injured, 7.

A closing word as to the present position of the industry. In France, the home of the autocar (or automobile, as it is called by the French), the industry is going forward rapidly. The principal makers, of whom there are only about four who stand out beyond the general trade, are overcrowded with orders, and some firms are refusing them. Panhard & Levassor, in a recent fortnight, booked $150,000 worth of orders. In Britain, while we write, the trials of mechanical vehicles for heavy traffic are taking place, and the War and Post Office departments are watching them with interest. The industry is slowly emerging from the disastrous stock-jobbing which characterized its early days, and is getting on a business footing. The successful journey of Mr. Sturmey, editor of The Autocar, from John O'Groat's to Land's End, has helped to popularize the autocar, as showing what it is capable of. In the United States, the movement is slower than anywhere else, largely, we presume, on account of the bad roads. Col. Pope has been bravely spending money in experiments with electricity, but the Pope electrical carriage has not yet been brought into general use. The Duryea carriage, which won the Chicago Times-Herald race, and the $3,000 Cosmopolitan prize at New York, does not seem to have recovered from the dazing effects of success, for we hear and see little of it now, though it is being manufactured in Springfield, Mass. The Winton, of Cleveland, is being pushed with some energy, and the inventor offers to put up $1,000 on a race from Chicago to New York, but stipulates that competing carriages shall carry only two passengers—which looks as though the Winton lacked the essential element of power, as do the other American motors.

The most important recent event is the heavy autocar trials at Liverpool, May 24th—28th, of which we give a summary. As a result, Messrs. Thornycroft are pushing the erection of an extensive factory for autocar manufacturing, at Basingstroke, while the Liquid Fuel Engineering Co. is selecting extensive premises in the Midlands for works for 500 or 600 hands, who will be employed solely in constructing "Lifu" cars.

HEAVY CLASS (FIVE TONS MINIMUM)—ONE ENTRY.

1. Thornycroft Lorry.—Steam Carriage and Wagon Co., Ltd., Chiswick. 6 wheels. Load carried by rear pair of wheels on platform resting on turn-table fixed over the rear wheels of the front portion of the vehicle, allowing motion in two places, so that wheel base could accommodate itself to road inequalities. Speed 5 miles an hour. Available floor space, 110 sq. ft. Tare (English) 3 tons 19½ cwt. (light); with fuel and water, in running order, 4 tons 5 cwt. Underframe and wheels of steel; roller bearings. Heating surface of water tube boiler, 65 sq. ft. Grate area, 2½ sq. ft. Test pressure 350 lbs. per sq. in. Fuel, steam—coal or coke. Engine horizontal compound with cylinders 4 and 7 in. by 5 in. Condenser of small copper tubes brazed together on roof of driver's cab silences exhaust, and blow-off from safety valve. Gearing has two speeds, engine making 9 or 12 revolutions to one of driving wheels. Powerful screw-down hand brake fitted to tires of driving wheels, and independent steam brake with pressure of 2¼ tons acts on wheels of trailing body.

LIGHT CLASS (TWO TONS MINIMUM)—THREE ENTRIES.

1. Thornycroft Car.—Tare, 2 tons 19 cwt. light, in running order, with fuel and water, 3 tons, 4½ cwt. Speed 6 to 8 miles per hour. Boiler, engine and mechanical details same as above, but gearing gives ratio of 8 to 1 from engine to driving wheels.

2. Leyland Van.—Lancashire Steam Motor Co. Platform area 78 sq. ft. Boiler, fire-tube type, with 110 sq. ft. heating surface. Weight, per sq. ft. of surface, is 6 lbs. Working pressure 200 lbs., tested to 450 hydraulically. Steam, which can be raised to working pressure in 18 minutes, is generated by liquid fuel, supply regulated by pressure on boiler, making firing automatic. Condensers on roof of cab make it unnecessary to carry any great quantity of water. In full work burns 1¾ gals. of oil per hour, costing 3½d. per gal. Inside of boiler can be lifted out for cleaning without removing any steam fittings.

3. Lifu Lorry.—Liquid Fuel Engineering Co., Cowes. 16 ft. 2 in. long, 6 ft. 6 in. wide over hubs. Wheels have bronze hubs, fitted with large reservoirs for lubrication. Steering by a handle connected to pivoted axles. Engine compound reversible, runs at 600 revolutions for speed of 8 miles per hour, geared down from 8 to 1. Water-tube boiler, 80 sq. ft. heating surface, capable of making sufficient steam to supply an engine indicating 35 h.p., and will easily indicate 25 h.p. without forcing. Boiler tested to 500 lbs. hyd. pressure, and safety valve set for working pressure of 250 lbs. per sq. in. Supply of oil to patent Lifu burner is automatically regulated by steam pressure in boiler, and set to ease the fire down at 225 lbs. pressure. Regulation of speed by means of h.p. cylinder valve, but when extra power required, high pressure steam is let into the h.p. cylinder. Brakes by reversing, also by foot brake, by steel bands around large gears fastened to rear wheels. Sand boxes are provided for greasy roads, and worked from driver's seat. Two oil tanks of 20 gals. each. Two water tanks, one of 60 gals., under driver's seat, one of 75 gals. under platform, are filled by steam injector. Weight of vehicle, without fuel or water, 38½ cwt.; with full supply, 54 cwt.; speed, 8 miles per hour on fair roads when fully loaded, and can climb grades 1 in 10 at 4 miles per hour.

The cars were loaded up with bags of gravel, and in addition to the "crew" were two "official observers" on each car, while another set of "observers" were placed in charge of the depot. The judges were: Sir David Salmons, Boverton Redwood, F.R.S.E.; Prof. H. E. Hele-Shaw, LL.D., M.I.C.E.; S. B. Cottrell, M.I.C.E., and Henry H. West, M.I.C.E. The competition lasted two days, covering two routes of 40 miles each. Several petroleum-driven smaller vehicles, and a steam wagonette, occupied by interested spectators, accompanied the competitors. The Autocar, to which we are indebted for particulars, says: "The Thornycroft five-tonner led off at a trot, with the Lifu bringing up the rear and dashing away in fine style after the rest, its funnel swaying about. . . . .

One incident of the first day's run was the bursting of a tube in the boiler of the Thornycroft 2½-ton van. This occurred when about half the journey had been made, and was undoubtedly due to the tube getting stopped up; a fact probably to be attributed to oil getting mixed with the feed water. The van was going so well, running easily and lightly with its load, and performed so favorably in other respects that it is much to be regretted this mishap should have occurred. The Leyland lorry lost two tires; the Thornycroft six-wheeler was delayed half an hour by getting a wheel stuck. The arrivals at Liverpool were as follows: Lifu, 5 p.m.; Thornycroft, two-tonner, 8 p.m. The Leyland ran after getting its tires put right, but had one wheel go to pieces entirely, and could not get home. Engineering, the well-known London technical journal, says of the end of the first day's trial "The Thornycroft 5-ton load van got in very late indeed, owing to the tire coming off. This was most unfortunate, as the journey was very nearly completed, and the wagon had gone exceedingly well during the day."

The second day's trial resulted in the following order: Lifu, Thornycroft two-tonner, Leyland. The third day the Leyland did not start on account of damaged wheel. The large Thornycroft kept on slow speed all day, and came in about 11 p.m. The fan of the small Thornycroft got out of order near the finish, but she raced home under forced draught. The Lifu had been injured the previous day by a steam carriage running into her, but she pushed through and finished the day's work at 4.30 p.m. On the fourth and last day, the Thornycroft six-wheeler made the run without accident and finished at 11 p.m.; the Leyland came through in good time, as did the smaller Thornycroft. The Lifu stopped twice to take water, and reached home by 3.30 p.m.

WHY THEY SAW NOTHING.

The report of the Canadian Government expedition to Hudson Bay last year has now been published. As was anticipated by those who knew somewhat of the circumstances under which the "Diana" was sent on her mission, the report is as little favorable to the Hudson Bay route as is possible without expressing too conspicuous an animus. It was currently reported in Canada a few years back that the Dominion Government would not take steps to develop the short northern route until the Canadian Pacific had got a fair start. The C.P.R. has not only got on its legs now—it is pretty well dominating the country, and does not mean to have any opposition if it can help it; and it has particularly set its face against the Hudson Bay route. It was very unfortunate, therefore, that the secretary to the expedition should have been a son of the secretary of the Canadian Pacific Railway, and that before starting on the expedition he should have had an "interview" with the president of the Canadian Pacific. It was even more unfortunate that Captain Wakeham—admirable sailor though he doubtless is—should have been chosen to command the expedition, as he was notoriously inexperienced in ice navigation, and, on his own confession in the report, this inexperience led him into difficulties which hindered his test passage through the strait.—From the London Saturday Review.

THE MASTER PLUMBERS' CONVENTION.

The convention headquarters was at the Hotel Victoria, Quebec. It opened June 29th, and at 10 o'clock a private meeting of the Executive Committee was held, composed of the following: Jos. Wright, Toronto, president; W. Smith, London, vice-president; W. M. Briggs, Montreal, treas.; W. Mansell, Toronto, financial and recording secretary; J. B. Fitzsimmons, Ontario; A. Picard, Quebec; T. Campbell, New Brunswick; G. A. Perrie, Nova Scotia; T. Stevenson, Manitoba, and Jos. Lamarche, Montreal. In the afternoon at 2.15 a general meeting of the convention took place, and at 8 o clock the business meeting was continued. On Thursday morning all the members attending the convention were photographed in a group, and other business meetings continued till the evening, when a banquet was held at the Victoria, to which the leading civic authorities and architects of the city were invited. Friday morning a drive around the city and different points of interest was indulged in, and a reception tendered the delegates in the City Hall by His Worship, the Mayor of Quebec. On Friday an excursion was made to the shrine of Ste. Anne de Beaupre over the line of the Q. M. & C. R. R. and on returning a stop was made at Montmorency to allow the excursionists to see the Falls. The election of national officers resulted as follows: President, W. Smith, London; vice-pres., J. W. Harris, Montreal; treas., T. Meredith, Toronto; sec., W. Mansell, Toronto; executive committee, A. Fiddes, Toronto; Jos. Lamarche, Montreal; Thos. Campbell, St. John, N. B.; M. Day, Halifax. Provincial vice-presidents, John Highman, Ottawa, for Ontario; E. Lesperance, Montreal, for Quebec; J. Doody, St. John, for New Brunswick; G. A. Perrie, Halifax, for Nova Scotia; W. Stephenson, Winnipeg, for Manitoba; M. J. Barr, Vancouver, for British Columbia.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

At the annual meeting of Kingston branch, No. 10, C.A.S.E., last month, the following officers were elected for the current year: President, C. Asselstine; vice-president, R. Bajies; secretary, J. L. Orr; treasurer, C. Selby; doorkeeper, S. Donnelly; conductor, G. Barrance; trustees, F. Simmons, C. Blomly.

Montreal, No. 1, C.A.S.E., held its annual meeting on the last Monday in May, when the following officers were elected: President, Geo. Hunt; vice-president, Wm. Ware; second vice-president, J. G. Robertson; recording secretary, H. Wilson; financial secretary, H. Nuttall; corresponding secretary, P. McNaughton; treasurer, Thos. Ryan; doorkeeper, John Huntingdon; conductor, Thos. Naiden; trustees, John J. York, John Huntingdon, O. E. Granberg; delegates to convention, Messrs. Huntingdon and Ryan.

The Canadian Association of Stationary Engineers' Unity, No. 5, London, Ont., elected the following officers at the annual meeting: Duncan McKinley, president; W. Blythe, vice-president; G. B. Risler, treasurer; W. Allen, cor. sec.; W. Meaden, rec. sec.; James Harding, conductor; Henry Geldart, guard. The installation of officers was carried out in a very efficient manner by the past president, J. D. Campbell.

The following are the new officers of Toronto, No. 1, C.A.S.E.: President, C. Moseley; vice-president, H. E. Terry; rec. sec., J. W. Marr, Davisville, Ont.; financial sec, A. Slute; treas., S. Thompson; conductor, W. Clark; doorkeeper, J. Long; trustees, J. Huggett, W. Webb, J. Fox. The officers were installed by past president Jno. Fox.

The annual convention of the Canadian Association of Stationary Engineers will be held this year in Hamilton, Ont., beginning on Aug. 8th. A most instructive and entertaining programme is being prepared, and the delegates will certainly enjoy a visit to so important a manufacturing centre as Hamilton.

PATENTS TO CANADIANS.

Fetherstonhaugh & Co., Patent Solicitors, of Toronto and Montreal, furnish us with the following list of patents, relating to machinery or engineering, granted to Canadians in the following countries. Any further information may be readily obtained from them direct.

Canadian Patents.—Amalgamators, M. Cross; wire fence machine, A. H. Cook; apparatus for amalgamating and concentrating precious metals, H. H. Earns; apparatus for the production and storage of acetylene gas, R. F. Carter; water heaters, R. Rushton; hay presses, R. McLoad; swing and slide farm gates, J. Pratt; shaft attachments, N. Green, automatic running board and guard rail combined, on the top of freight cars, J. Carmichael; seed drill disc shoes, N. Stephenson; cradles, C. Gay; straw cutters, A. Johnston; drain ditching plough devices, W. Hawker; valves, C. H. Volmann, liquid fuel burners, C. M. Cookson; machine for weaving wire fence. J. Roch; section valve for automatic fire sprinklers, E. J. Phillip; fire escape, J. McNeil; earth boring augers, Z. Leroux; tension for the binding mechanism of harvester binders, T. H. King; brakes, A. Desbains.

American Patents.—Motor, T. A. Brennan; grappling-hook, T. David; sheet-metal vehicle-wheel tire, J. Jamieson; brake, A. Desbains; thawing apparatus, R. B. Ormiston; pulley, H. S. Pell; electromagnetic-switch railway, A. Norman; vessel and sail and rigging therefor, C. Twining.

WATERPROOF STONEWORK.

What was at first considered a doubtful experiment, viz., the use of coal tar as a means of rendering masonry impervious to water, especially in positions exposed to direct contact with the latter, has proved a practically valuable resort, says Paving and Municipal Engineering. Used as a coating for masonry, built up of very porous stone, tar renders it quite impervious even at a depth of some fifty feet of water, and, according to the opinion of those whose experience has been extensive with it, the article should be utilized in all public buildings, particularly those designed for the preservation of works of art, the dissolving action of water, even upon mortar of superior quality, being well known, and also the unfavorable effect of the exudation of water charged with lime salts from the mortar. Two different methods of using the tar are named, viz., in a boiling state in one or several layers, this being suitable for surfaces exposed to the air, or it may be made to flame up before using, this being appropriate to surfaces which have to be covered up. It is stated that when boiling coal tar is employed in three coats on masonry, the result is a black and very brilliant varnish, which perfectly resists the action of frost, water and sun, being likewise absolutely impervious; and the tendency of the black coating to absorb heat may be overcome by white-dusting the whole before the tar is quite dry.

ELECTRIC POWER AT SAULT STE. MARIE.

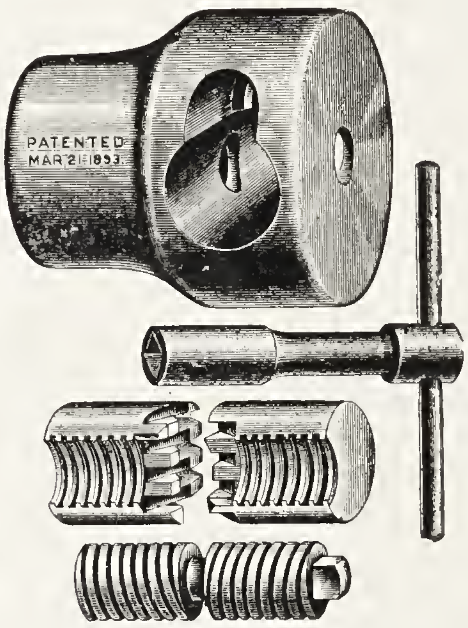
Great things are to be accomplished at the two "Soos," according to F. H. Clergue, president of the Lake Superior Power Company, at Sault Ste. Marie, Ont. Two hundred delegates of the North-West Electrical Convention visited the two towns a short time ago, and Mr. Clergue, addressing the delegates, said: "The Lake Superior Power Company have added to their present investment, the Power Canal at Sault Ste. Marie, Ont., by the purchase of the rights of the abandoned power canal on the American side of the rapids, and have added to the property thus acquired large tracts of land in addition, sufficient to permit of the construction of a hydraulic canal of about 50,000 horse-power. The plans for the construction of this canal have been completed, the specifications have been issued to contractors, and July 1st the tenders will be opened and the contracts awarded. The constructions provided for in the specifications consist of a hydraulic canal 22 feet in depth and 250 feet in width, terminating in a power station constructed of stone, and extending for a distance of

1,200 feet along the water front. This will be the largest hydraulic plant yet constructed, and will contain 80 electrical dynamos, of 500 horse-power each. The cost of this development will exceed $3,000,000, without including the cost of the mills and factories, which will utilize the power thus created. One-half of the entire power generated by the canal has been sold to the Union Carbide Company for a period of 25 years, and the remainder of the power will be devoted to metallurgical uses. The contracts call for the completion of all this work within three years from July 1st, and at its completion it is the intention of the Power Company to continue their operations by large additions to their works on the Canadian side."

Mr. Clergue explained that it was not the intention to begin the construction of a second water power canal on the Canadian side of the river until the end of the work on the American side of the river was completed, which would be in about three years. The new power canal on the Canadian side would have three times the capacity of the present canal, and it would cost about $500,000. The reduction works, which would be constructed at the Canadian Soo, immediately afterward, would not cost less than $1,000,000 more. After the canal and works were completed, the reduction works would give permanent employment to nearly 1,000 men, most of whom would be skilled workmen.

THE HORTON DRILL CHUCK.

As shown by the engraving, this chuck is simple in construction and very strong and durable in all its parts. The body is composed of one piece of metal and the entire chuck of four pieces. Chucks in ¼" and ½" sizes are made of steel, and in the larger sizes the working parts are of steel, the jaws are so constructed that there is no danger of breaking or crimping the drill by gripping as in many drill chucks. The right and left hand screw, which drives the jaws. is set deep into the latter so that an end thrust with jaws is obtained and consequently a stronger grip with no danger of breaking the screw. The jaws are cylindrical and the power of the screw, being applied more direct, there is no binding or canting of the jaw when taking a short bite, as is the case with the 2 jaw chucks made with the old-fashioned, angular jaw set in a rectangular slotted body. This chuck is made in six sizes, as follows: ¼", ½", ¾", 1", 1½", 2". The 1½" and 2" sizes are attached to the spindle of the machine by means of a face-plate and screws, the same as an ordinary lathe chuck. These chucks may be had from the Aikenhead Hardware Co., 6 Adelaide St. East, Toronto.



The Horton Drill Chuck

TIDAL MOTORS.

Editor Canadian Engineer :

Sir,—An article under the heading "The old Tide Mills of Brooklyn," at page 371, of June 11th No. of the Scientific American for 1898, leads me to wonder how engineers are and have been striving after some ingenious automatic float arrangement for utilizing the force stored up in and to be had from the daily rise of tides in Canada and other parts of the world, when it would seem to be so much more simple to follow the practice of by-gone ages, by damming up the water as the Hollanders of yore did at Brooklyn. And if the practice paid there, where the tides, I believe, rise but a few feet, how much more prolific would they not be along the St. Lawrence below Three Rivers, where, as at Quebec, the neaps are 14 feet, and the springs as much as 22 or more; or again, in the Bay of Fundy, N.S., where the rise varies from 30 to 60 feet.

To get sufficient power from a float, it must evidently be of very large size, and therefore, the larger the more expensive; the price increasing as the area or square of its dimensions—while in the barring of a creek or ravine or mouth of a tidal river, the cost would be enhanced only in the ratio of the length of dam, the area of water enclosed increasing in almost any ratio. It would therefore seem that the simplest and most economical mode of utilizing the rise of the tide would be to proceed as in the impounding of water for an aqueduct; establishing all along the face of the dam a series of automatic gates, opening to the rising water and closing at ebb; when side issues from such a body and bearing only a relatively small proportion to the bulk of water held up, could be utilized either through turbines or undershot wheels for a variety of purposes.

Chas. Baillarge, C.E.

It is now about three years since the Syracuse Smelting Works first introduced their Syracuse babbitt metal into Canada. It has since been giving great satisfaction, so that they have been constantly asked by numbers of their large customers to start works in Canada. They have at last done so, and have established works on the corner of St. Thomas and William sts, opposite the street railway powerhouse, Montreal. With the two furnaces set up they are able to turn out four tons of babbitt metal per day. Finding that they cannot fill their orders on stereo, electro and linotype metal as well as solder they are now preparing to build one more furnace for making babbitt metal and one for solder and other metals. They have laid in a large stock of raw material, such as pig tin, pig lead, antimony, ingot copper, ingot brass, as well as scrap copper, scrap brass, aluminium and numerous other metals, so as to be able to supply all customers with everything in the line of metal that they may require. The business will continue to increase on account of the quality and price of the metals supplied by this company.

THE AMERICAN STOKER COMPANY.

We have been requested by the American Stoker Co. to publish the following letter:

Montreal, June 29, 1898.

The General Engineering Company of Ontario, Limited,
80 Canada Life Building,
Toronto, Ont.

Dear Sirs:—The American Stoker Company, having an office at room 54, Street Railway Chambers, Montreal, have submitted to us your circular letter, dated 26th of May, 1898, in which it is stated that the American Stoker now being introduced into Canada by the American Stoker Company, is an infringement on certain alleged Canadian patents owned by you, and that as soon as the American stoker is installed in Canada, your solicitors have been instructed to take proceedings in the Exchequer Court of Canada against the user as well as against the manufacturer and importer, and warning the public against the use of the American stoker. We are instructed by the American Stoker Company to inform you that the stokers manufactured by our clients are protected by Canadian patents and are not an infringement of any patents legally held by your company.

We are also instructed to inform you that the American stoker company have sold and delivered five stokers to the Dominion Cotton Mills Company, and are about making delivery of stokers to other purchasers in Canada, and are prepared to defend any action for infringement or damages which may be brought by your company in virtue of such sales for the use which may be made by the purchasers of these stokers, and we are authorized to accept service of any legal proceedings which you may bring against the American Stoker Company.

We have further to inform you that in the event of your Company not making good your threats contained in your circular letter within fourteen days from this date, which are calculated to deter prospective users of the stokers from purchasing from our clients, we are instructed by the American Stoker Company to institute legal proceedings against you for damages, and for an injunction to restrain you from threatening legal proceedings on the ground of alleged infringement of patents. All other rights are reserved.

Your obedient servants,
MACMASTER & MACLENNAN.

FIRES OF THE MONTH.

June 1st—The Union Abattoir Co.'s buildings, St. Henri, Montreal; loss about $150,000.——June 4th—Dixon & Gibbon's spice mill, Winnipeg; machinery destroyed.——June 4th—D. LaLiberte's foundry and machine shop, St. John's, Que.; loss about $3,000.——June 5th—S. R. Foster's pottery, Hamilton, Ont.; loss about $4,000; insurance, $2,700.——June 5th—A. Smith's stove mill, Fesserton, Ont., detroyed.——June 10th.—Jos. Bourque's planing mill, Hull, Que.; loss about $8,000.——June 13th—Acton, Ont., Tanning Co.'s premises damaged to the extent of $500.——June 14th—John McCleary's saw mill, Bristol Ridge, Que.; total loss.——June 14th—Burley & Galligan's foundry and machine shop, Rat Portage, Ont.; loss, $25,000.——June 15th—The Sherbrooke Yarn Mills and C. E. Shedrick's, electrical instrument maker, Sherbrooke, Que; loss partially covered by insurance. C. F. Shedrick's business was continued at once.——June 18th—R. Arnott's cheese box factory, Peterborough, Ont.; destroyed; insurance, small.——June 19th—Oxbow, N. W. T., Milling Co.'s flour mills; no insurance.——June 19th—R. Sloate's saw mill, Tracey's Mills, N. B.; loss, $8,000.——June 21st—The Coleman Lumber Co.'s planing mill, Burlington, Ont.; loss about $10,000——June 23rd—Buck's Stove Works, Brantford, Ont.; pattern shop destroyed.——June 23rd—A. McDonald's saw mill, Peterborough, Ont.; insuranee, $3,000.——June 24th—W. W. Doherty's saw mill, Campbelltown, N. B.; loss, $10,000; no insurance.——June 26th—Clifton Hotel, Niagara Falls, Ont., $60,000.——June 29—T. Ebbage's planing mill, Acton, Ont.; loss, about $700.——July 2nd—Court house and jail, St. Thomas, Ont.; loss, $50,000.——July 2nd—G. H Harper & Co.'s flour mill, near Dundas, Ont.; loss, about $20,000.——July 5th—St. Bernard's convent, Antigonish, N. S.; loss, $25,000.

A POCKET VOLTMETER.

The Whitney Electrical Instrument Company, Penacook, N H., is manufacturing a line of pocket voltmeters and milammeters for continous current. They are made in the form of a watch, as will be seen from the accompanying illustration of the voltmeter.

This instrument has a range from zero to five volts, and was designed to meet a demand among battery users for a low reading and convenient voltmeter. The principle of construction is the same as that of the Whitney Company's standard portable voltmeters for direct current, and the instrument is built with the same care. It is accurately calibrated, and the scale is drawn in by hand. The works are mounted in a handsome silveroid case, which will remain bright indefinitely, and is about the same size as a gentleman's watch. With this pocket voltmeter, the operator of an electric vehicle, or the engineer of an electric launch, can quickly determine which of his accumulators are "dead" and cut them out, thereby getting the full benefit of the good cells.

☞ These instruments are being manufactured in Sherbrooke, Que., by C. E. Shedrick, whose catalogue also contains a large number of other interesting features.

STEAM VS. ELECTRICITY.

The report of James Milne, the expert employed by Toronto to make a report on the cost of an electric power supply for street lighting and commercial purposes has been made. Mr. Milne reports that the data received from the users of both electric and steam power is not to be absolutely relied on for the purposes of careful calculations, owing to the different bases upon which the various returns have been prepared. The summary of the steam users shows a consumption of 16,802 horse-power, from which 10,000 may be deducted for the Toronto Railway Company, Toronto Electric Light Company, Incandescent Light and Corporation plants, leaving 6,802 horse-power for commercial purposes. Of this amount he says, nearly 1,000 horse-power could be supplied by electric power or gas as cheaply as at present, but for the remaining 5,800 horse-power it is useless trying to persuade the manufacturers to change from their present methods, because some profess themselves well satisfied with the steam plants already installed; some use refuse for fuel, some require steam for heating, drying, etc., and others wish the source of their power to be independent. Mr. Milne also stated that in many businesses the cost of power was a very inconsiderable part of the expense of production, and the saving to be made by using electricity not sufficient to make the change desirable.

Railway Matters.

Truro, N.S., has voted a bonus of $30,000 to the Midland Railway.

The C.P.R. authorities have increased wages all around about ten per cent. to the trainmen in the Ottawa and Quebec division.

The Grand Trunk Railway has ordered ten hundred and fifty double-deck stock cars from the Michigan Peninsular Car Company.

The city of Brantford, Ont., is asking the G.T.R. to spend $7,000 in extending the bridge in connection with the proposed flood-prevention works.

The C.P.R. is making a large addition to the rolling stock at the Perth, Ont., workshops. There are 250 flat cars, 200 box cars, and 50 coal cars now in the course of construction there for use generally over the road.

The surveys have been completed on the Nelson and Bedlington Railway, which will give West Kootenay's mining centre of Nelson, B.C., direct communication with the United States, via Bedlington, a point near the Idaho boundary of British Columbia.

There are four parties in the field working the surveys for the new C.P.R. line north from Toronto. H. D. Lumsden is chief engineer, and the chiefs of the parties are Messrs. Brunel, Mitchell, Morris and C. B. Smith, whose districts are respectively French River to Sudbury, French River to Parry Sound, Parry Sound to Severn River, and Severn River to Kleinburg.

The C.P.R. is willing to spend $75,000 on yards and shops at Calgary, N.W.T., but object to the conditions which the council sought to attach to the $25,000 bonus. The conditions suggested by the council included the inspection of the company's time sheets and a forfeit if the C.P.R. shops moved from Calgary before 25 years.

The Windsor station of the C.P.R. at Montreal is to be enlarged by the addition, entailing the outlay of a quarter of a million dollars, or possibly more. The extension will be west on Osborne street, and will make the building twice its present size. It will be of the same material and in the same style, and when finished will make one of the most complete railway offices and depots on the continent.

It has been stated that the G.T.R. would shortly commence the construction of a line from a point on the Northern to the Sault. The line will run northwest, crossing the French River in the township of Mowat, and striking the Sault branch of the C.P.R. at Massey. The G.T.R. have running powers over portions of the road from Massey to the Sault. A good deal of grading and rock cutting was done some years ago on the line east of Massey.

The Robson-Penticton Railway has been surveyed to connect with the C. & W. at Robson, thence up the Lower Arrow Lake to Dog Creek; up this stream to McCrea Pass; thence down McCrea Creek and Christine Lake to Cascade City; along Kettle River to Grand Forks; up the north fork and Brown's Creek to Eholt Pass; down Eholt Creek to Boundary Creek, and through Greenwood, Anaconda and Boundary Falls to Midway. The route is 100 miles long and is filled with engineering problems.

The annual meeting of the Quebec Central Railway was held in London, England, on June 6th. It was reported that the gross earnings for the year ending December 31 last, amounted to $457,643, being an increase of $60,537 over those of the preceding year. The working expenses amounted to $309,555, being an increase of $40,761. The net earnings were $148,088, being an increase of $19,776, to which was added interest on balances, etc., $2,830, and there had been written off some items amounting to $2,954, making the available net revenue $147,964. After paying interest on the prior lien bonds, $85,166, there remained a balance of $62,798, out of which a dividend of one and one-half per cent. had been declared and paid on the income bonds, leaving $13,450 to be carried forward. The percentage of the working expenses was 67.64 per cent. as compared with 67.68 per cent. for the previous year.

It has been proposed that the Central Ontario Railway, from Picton to Coehill, be extended into the mining district.

The Alberta Railway and Coal Co. of Lethbridge, N.W.T., has ordered two more Munford Improved Boilers of 150 horse-power each from the Robb Engineering Co., Amherst, N.S.

The St. Hyacinthe and Granby Railway proposes building a bridge across the Yamaska and a passenger depot. The proprietors have petitioned the St. Hyacinthe, Que., council for a grant of $75,000.

The engineers in charge, Lauthier and O'Dwyer, have completed the final location of the Great Northern Railway, between Shawenegan and Montcalm, a distance of 53 miles, which completes the gap between the constructed sections of the railway.

Three hundred men have started work grading the right of way for the proposed railway from Skaguay to the lakes. The work is being done by the Pacific and Arctic R. & N. Co., of West Virginia, which is said to have secured the charter and holdings of the British Yukon Company.

The track-laying on the Ottawa and Montreal road, the new C.P.R. short line, has been completed. All that now remains is to make the connection with the Canada Atlantic Railway tracks and complete the ballasting. Some 250 carloads are being deposited on the line every day. The bridge across the Rideau is completed and is being painted. All the stations along the line are ready for occupation.

Electric Flashes.

The town of Thorold will borrow $7 000 to extend the municipal lighting plant.

The Great Northwestern Telegraph Company has completed an extension of their line into British Columbia.

The Little Salmon River Telephone Company applies for an extension of its charter powers and it will then extend its lines.

E. I. Sifton has been appointed manager of the Electrical Construction Co., London, Ont., in place of S. R. Break, who has gone to Arizona.

John R. Coffman, who for the past year has filled the position of superintendent for the London Electrical Construction Co., has returned to Detroit.

The Toronto Railway Company has placed an additional order for ten C.G.E. 1,000 two motor equipments with the Canadian General Electric Company.

The Montreal Street Railway Company has erected a new brick blacksmith shop at Hochelaga, 75 by 58 feet; the building is also to be used for the company's repairing work.

The town of Acton, Ont., is contemplating the installation of a municipal electric lighting plant. The estimates were supplied to the council by Mr. R. J. Parke, consulting electrical engineer.

The Wm. Cane & Sons Mfg. Co., Ltd., of Newmarket, has placed an order with the Canadian General Electric Company for a 17½ kilowatt four-pole lighting generator and marble switchboard.

Ladies ran the street cars of Cornwall, Ont., on the 15th of June, and a percentage of the earnings of the road on that day, which were large, were given to the General Hospital and Hotel Dieu.

C. E. Shedrick, manufacturer of electrical measuring instruments, Sherbrooke, Que., suffered considerable damage from smoke and water when the Sherbrooke Yarn Mills were burnt down, June 15th.

R. Prefontaine, Ste. Agathe des Monts, Que., has placed an order with the Canadian General Electric Company for a one thousand-light single phase standard ironclad armature type of alternating current generator.

The town of Listowel, Ont., is considering a by-law impowering the municipality to borrow $19,700 for waterworks and electric lighting. The plans and estimates for the work were prepared by John Galt, C.E., Toronto.

The Quebec electric railways and the Quebec, Montmorency and Charlevoix railways have been amalgamated and will have a working capital of $3,000,000. It is stated that the company will buy the Montmorency Falls outright.

The Shawenegan Water and Power Co., which has been incorporated to develope and utilize the water power at Shawenegan, Que., will not manufacture pulp at present, it has been decided, confining itself to the production of power. The incorporators of the company are David Russell, Montreal; John Joyce, Boston; William Strachan, Montreal, and others. Thos. Pringle, Montreal, has the work of development in hand.

The Berlin, Ont., Electric Light Co. has bought a 165-h p. boiler from a London, Ont., firm.

The Hamilton Electric Light and Power Company, Ltd., has placed an order with the Canadian General Electric Company for a 200-kilowatt 250-volt generator which they intend using on their power circuit.

The flow of the river Credit was recently measured by parties interested in electrical development in Toronto. It is hardly probable that the volume of water will be found sufficient to produce any very considerable power.

During May the Galt, Preston and Hespeler Street Railway handled 950 tons of freight, a slight increase over the corresponding month of last year, and carried 18,000 passengers, an increase of about 500 over May, 1897.

The first electric car traversed St. Thomas' streets June 15th. The electric street railway begun March 24 has been completed, and was opened for public travel on the 16th. The road is six miles in length and cost $80,000. The formal opening was held July 5th.

The Cornwall, Ont., Electric Street Railway Company, Ltd., in consequence of the increased demands on the freight service, has ordered another freight locomotive and has placed an order with the Canadian General Electric Company for the electrical equipment, consisting of four C.G.E. 1,200 motors.

The Pembroke Navigation Company has placed an order with the Canadian General Electric Company for equipping the steamer "Victoria" with a complete electric lighting plant, which will include a six-kilowatt standard Edison type dynamo, a vertical automatic engine and a search lamp of 4,000 candle power.

Judge McDougall has handed out judgment granting the motion to quash the indictment preferred at the December Sessions, 1897, against the Toronto and Mimico Railway Company, charging the latter with running their cars on Sunday, contrary to 60 Victoria, cap. 14 sec. 95, and sec. 138 of the Criminal Code. This allows the line to run Sunday cars.

The Canadian Pacific Railway, which has recently acquired the smelter at Trail, B.C., formerly operated by Aug. Heinze, has concluded negotiations with the West Kootenay Power and Light Co. for the supply of electric current to operate the smelter, and have ordered from the Canadian General Electric Co. two 75 k.w. three-phase revolving armature type synchronous motors, which will be operated at a potential of 550 volts. They have also ordered three 50-h.p. induction motors and three 30-h.p. induction motors which will also be operated at a potential of 550 volts.

The Lang Tanning Co., Berlin, Ont., has recently given an order to the Canadian General Electric Co. for a 100-k.w. multipolar direct current dynamo, which will be operated at a potential of 250 volts. This generator will supply current for the operation of two of the Canadian General Electric Co.'s latest type of multipolar direct current motors, each having a capacity of 50-h.p. and one 10-h.p. motor. The order given to the General Electric Co. also includes the installation of a marble panel switchboard, containing the necessary instruments for the operation of the plant and the wiring up of their factory.

A. E. Carr, superintendent of the London, Ont., Street Railway Company, has been appointed superintendent of the Montreal Park and Island Railway, in succession to A. J. Corriveau, who recently resigned. Mr. Carr still retains his position with the London company, and will, it is said, manage both jointly. When only sixteen Mr. Carr was secretary-treasurer of the sewer department at the Toronto city hall, and had after that experience as private secretary to H. A. Everett, formerly of the Toronto Railway Company. He was appointed to his present position in London in 1895.

The Carborundum Company, of Niagara Falls, has commenced the manufacture of its product in Canada under the patent which it holds. It has just built a new factory building at Niagara Falls, Ont., but the electrical apparatus not having arrived in time for the plant to be utilized in accordance with the patent provisions, in order to maintain its rights, the company, with considerable enterprise, erected a furnace in the power house of the Niagara Falls Park and River Railway Company and there made the first carborundum produced in the Dominion. Carborundum has been increasing in popularity, and the output on the New York side of Niagara has been materially increased. Now the company is erecting a three story brick building, 50 x 228 at the foundation, in which they will spread carborundum on cloth and paper, thus bringing carborundum in competition with the flint, garnet and other paper manufactures in the United States, of which, it is said, there are seven or eight. This new branch of the company's business is expected to reach large proportions, and it is expected that it will make necessary a still further increase of the carborundum producing plant. The president of the company is E. G. Acheson.

The Lakeport Preserving Co. has given an order for the installation of a lighting plant for its factory to the Canadian General Electric Co.

The Electric Co. of St. Johns, Nfld., is increasing its plant and has ordered a 150-h.p. tandem compound engine from the Robb Engineering Co., Amherst, N.S.

For the rebuilding of the retaining walls of its railway the Hamilton and Barton Incline Company has awarded the contract to Rowan & Elliott, of St. Catharines, Ont.

The Toronto Railway Co., which recently ordered a number of the Canadian General Electric Co.'s well-known type of C.G.E. 1,000-motors, has given an order for additional equipments.

The Strathroy, Ont., Electric Co., Ltd., has met with so much success that it has recently placed an order with the Canadian General Electric Co. for the installation of another 500-light single-phase alternator.

The Toronto Electric Light Co. has been ordered by the city council to extend its system to the Island at 20½ cents per light, as the Island is part of the city and the company's charter covers the whole city.

The R. Forbes Co., Ltd., Hespeler, Ont., has placed an order with the Canadian General Electric Co. for two 500-light Generators. These generators are to be supplied of the Canadian General Electric Co.'s latest four-pole type.

Hon. John Haggart, Perth, and others, have been incorporated under the name of "The Canadian Electric and Water Power Company," with a capital stock of $150,000, to produce and distribute electricity in Perth, as well as in other towns in Canada.

La Compagnie Manufacturiers et Electrique de Montmagny has given an order to the Canadian General Electric Co. for a 100-k.w. monocyclic generator, which will be operated at a potential of 2,080 volts, together with the necessary station instruments for the operation of the plant.

The West Kootenay Power and Light Co., who have just closed a contract with the C.P.R. authorities for the supply of electric current to operate their Trail smelter, have placed an order with the Canadian General Electric Co. for the supply of three 135-k.w. transformers of the well-known air blast sub-station type.

The Lachine Rapids Hydraulic and Land Co., of Montreal, has given an order to the Canadian General Electric Co. for the installation of a seven-panel power-house switchboard, which is to be built in accordance with specifications and drawings prepared by R R. Kelsch, superintendent for the Lachine Rapids Hydraulic and Land Co.

The citizens of Hamilton will vote on July 27th to decide the following questions about the street railway: 1. Shall the city purchase and operate the Hamilton Street Railway? 2. If the city does not now purchase the Hamilton Street Railway, should the council extend the franchise of the company for fifteen years, that is until 1928?

The town of Granby, Que., recently gave the contract for the installation of its lighting plant to the Canadian General Electric Co. This plant will consist of a 100 k.w. monocyclic generator, complete equipment of station instruments and a 50-light "Wood" arc dynamo. The contract also includes the complete installation of the pole line, transformers and house wiring required.

The city of New Westminster is resisting the proposal of a company, of which F. S. Barnard is a director, to tap the waters of Coquitlam Lake, with a view to electric power. The city authorities believe that New Westminster will need all the water it can get for public uses from the lake, over which it has, under Act of the legislature, rights of user as a city reservoir.

The Hudson Bay Co. has given an order to the Canadian General Electric Co. for the installation of a complete lighting plant for its stores at Calgary, N.W.T. The plant will consist of one of the Canadian General Electric Co.'s latest four-pole type generators, having a capacity of 9 kilowatts. The Goldie & McCulloch Co., Ltd., Galt, Ont., is supplying the engine and boiler required for this installation.

The works of the Ottawa Carbon and Porcelain Company are very busy at the present time. This is the only factory in Canada for the production of electrical porcelain and carbon goods, and ever since its establishment in the capital city it has made steady progress. At first the carbons produced were in some cases not up to the mark, but great improvements have been made in the process of manufacturing, and the carbons turned out this year by the company are equal to any imported goods. Besides the carbon goods for electric light purposes, the company manufacture motor brushes, and specialties in carbon for telegraph and telephone work as well. The porcelain goods include door knobs and other goods used in the hardware trade, as well as porcelain insulators, etc.

The Electric and Operating Co., Brantford, Ont., will spend $10,000 in enlarging its plant in consequence of the civic lighting contract recently entered into.

The Electric Co., St. Johns, Nfld., is increasing its plant and have ordered a 150 horse-power Tandem compound engine from the Robb Engineering Co., Amherst, N.S.

The Niagara Falls Park and River Railway Company ran their first trolley over the arch bridge July 1st. Mr. Rothery, superintendent of the road, was at the motor; Manager Phillips and Bridge Superintendent Dill, together with a number of other prominent citizens, were inside.

Personal.

J. R. Joughins has been appointed master mechanic of the Intercolonial Railway.

T. C. Keefer, C.E., Ottawa, was elected president of the Royal Society of Canada at its last meeting.

John Kelman, formerly of Galt, Ont., is superintendent of the Stanley Electric Mfg. Co, Pittsfield, Mass.

Thomas Graham, of the Banner File Works, Almonte, Ont., has recovered from his recent very severe illness.

J. Walter Wells, of the Kingston School of Mines, has been appointed to take charge of the assay office at Belleville, Ont.

Jas. Devlin, formerly chief engineer Kingston Penitentiary, is now one of the proprietors of the Albion Hotel, McGill st., Montreal.

C. J. Crowley, Toronto, resident engineer for the Midland Division of the Grand Trunk, severed his connection with the road on June 1.

A. P. Rankin, marine architect and engineer, formerly of Toronto, is now engaged at the works of the Cleveland Shipbuilding Co., Cleveland, Ohio.

T. W. Hugo, formerly of Kingston, Ont., is now consulting engineer for the elevator system in Duluth, Min., as well as for the electrical railway system.

A. K. Spotton, for some time draughtsman with the Waterous Engine Co., Brantford, Ont., has secured a similar position with a Toronto firm.

John O'Brien, formerly miller for Gould Bros., Uxbridge, Ont., was so badly injured by mill machinery at Creemore a short time ago that he died.

Yorke Kirton, who has been in the employ of the Lancaster Machine Works for the past five years, has gone to the works of John Bertram & Sons, Dundas, Ont.

James Stephenson, ex-general superintendent of the Grand Trunk, has, with Mrs. Stephenson, taken up his residence in a pleasant villa in the town of Cheltenham, England.

Dr. Bowen, who has been president of the Thousand Island Carriage Co. since the manufactory started, has resigned his position, and will resume the practice of medicine in Gananoque, Ont.

Henry Penton, formerly of Sarnia, Ont., now holds the position of superintendent of the engineering department of the Chicago Shipbuilding Company, one of the largest institutions of its class on the great lakes.

Wm. Mailing, the Rat Portage, Ont., agent of the Ottawa Powder Company, met with a serious accident recently which will deprive him of the use of one of his eyes. It appears that Mr. Mailing was testing a new electric battery with a percussion cap, when the premature explosion occurred, with the result that the full force of the cap expended itself in the neighborhood of his eyes.

J. H. C. Haldane, C.E., of Liverpool, England, has been travelling in Canada lately with a view of getting up a volume describing the country from the point of view of its engineering possibilities. Mr. Haldane has already published a number of books, among which are "Civil and Mechanical Engineering Popularly Considered," and "Steamships and their Machines from First to Last."

George A. Macagy, for the past three years superintendent for the hardware firm of Peck, Benny & Co., Montreal, died recently in Montreal very suddenly. Mr. Macagy had enjoyed uniform good health during the forty-seven years of his life. However, he complained of a slight indisposition, and died before medical aid could be summoned. He was born in Halifax, N.S., in 1851. Moving to Toronto while quite a young man, he entered the hardware firm of Rice Lewis & Sons, of that city, with whom he remained for seven years. He then came to Montreal, and was for seven years secretary of the Pillow-Hersey Company. Three years ago he became superintendent for Peck, Benny & Co.

W. M. Cathels, for twenty years secretary and manager of the Gas Light Co., Fredricton, N.B., has resigned his position to accept a situation in Brantford, Ont.

William Young, who has been for a number of years chief engineer on one of the Pacific mail steamers running between San Francisco and Panama, has retired from active service and returned to his home in Galt, Ont.

Michael Kelly, who died recently in Montreal, will be lamented by a large number of friends. Mr. Kelly had been recently appointed inspector of timber for the port and district of Montreal. In Quebec, Mr. Kelly was recognized as the best inspector of timber in the country, and when the timber trade largely moved to Montreal he was transferred there by Hon. John Costigan.

Ephrem Valiquette, president of the Ingeneurs-Mecaniciens Association Canadienne de Secours Mutuels, who was the winner of the gold medal at the Industrial and Mechanical Course at the Monument National, is the son of a farmer, born on June 18, 1865, at St. Martin, Laval county, Que. He is provincial boiler inspector, and also a member of the Canadian Association of Stationary Engineers. Mr. Valiquette, who has recently left the employ of W. Rutherford & Sons, was presented on that occasion with a handsome silver water jug, as a token of respect, on his leaving their employ, to become foreman for Lymburner & Mathews, mechanical engineers, of Montreal, where he is now employed.

D. W. Crockett, who died a short time ago at Hopewell, N.S., was widely known throughout the province, and particularly in Eastern Nova Scotia, where in former years he had extensive business relations. For many years he had been a government surveyor and was closely connected with the development of gold mining in the Goldenville district, having resided in Wine Harbor and other parts of Guysboro county for several years. He assisted in the construction of the telegraph line from Halifax to Guysboro and was connected with several other important enterprises in Guysboro county. He was one of the chief promoters of the Hopewell Woolen Mill Co., Ltd., of which he was secretary and manager until the property was destroyed by fire ten or twelve years ago. Chas. M. Crockett, a partner in the engineering firm of I. Matheson & Co., New Glasgow, N.S., is a son of the deceased.

Marine News.

The Yarmouth, N. S., Steamship Co., has placed the new steamer "Express" on the South Coast service.

The steamer channel running to the wharf at Depot harbor, Parry Sound, has a depth of 30 feet at the shallowest points.

The contract for the iron work of the hydraulic lift lock in Ashburnham, Ont., has been awarded to the Dominion Bridge Works, of Montreal, they being the lowest tenderers.

The contract for transporting the yearly supplies to the Government light-houses in inland waters has been let to the steamer "Seguin," owned by J. B. Miller, of Parry Sound.

Captain Pratt, Cheverie, N. S., is going to place a steamer on the route between that place, Windsor and St. John. The engines are being built at Yarmouth by the Burrell Johnson Iron Company.

The new steamer of Boutilier and Moorehouse, Centreville, Digby County, N. S., is at the works of the Burrell Johnson Iron Company, Yarmouth, N. S., having her engines and boiler placed on board.

The contract for the iron work of the hydraulic lift lock in Ashburnham has been awarded to the Dominion Bridge Works, of Montreal, they being the lowest tenderers. This is one of the largest contracts, in a single structure in iron work, that has ever been let in Canada.

The Davis Dry Dock Co., Kingston, Ont., is rebuilding at a cost of $5,000 the C. P. R. car-ferry steamer "International," which runs between Prescott, Ont., and Ogdensburg, N. Y. The same firm has a 35-foot steam yacht nearly completed, which has been built for the Muskoka lakes to the order of S. E. Gill, Steubenville, Ohio.

The steamer "Lynne," which made its maiden trip to Depot Harbor, Parry Sound, with a cargo of 214,500 bushels of corn on a draft of 19 feet, served to show what we may expect from the future development of this great port.

James Finney, of St. Thomas, has been awarded the contract for building a bridge over the Otter Creek between Elgin and Oxford.

Bras d'Or Steamboat Company, Limited, has applied for a Nova Scotia charter to carry on a general ship-owning business; capital, $20,000.

A new contract will be necessary for the reconstruction of the breakwater and repairs to piers at Goderich, Ont. The contract was originally awarded to Luke Madigan at $50,099, but he was unable to carry out the work

The Beaver Line steamer "Lake Winnipeg" is to be replaced by the New Zealand Royal Mail Shipping Co.'s steamship "Tongariro. This vessel, which has a speed of 14 knots, can accommodate 120 saloon, 70 second cabin and 250 steerage passengers.

J. D. Reid, M. D., Cardinal, Ont.; G. F. Benson, Montreal, P. Q.; D. Gow, M. D., Cardinal, Ont.; G Hall, Ogdensburg, N. Y.; J. K. Dowsley, Prescott, Ont., have applied for incorporation as The Prescott and Lake Superior Navigation Company, Limited; capital, $100,000.

The "Eurydice," the property of Sylvester Bros, Toronto, has been sold to Campbell & Rosenecke, of Buffalo, for about $6,000. The "Eurydice" has been the subject of considerable liquidation recently. Last summer she was sold to parties at Port Stanley, the price agreed upon being $10,000. The purchasers afterwards refused to receive the boat, however, and took action against the owners. The new purchasers, it is understood, will run the "Eurydice" between Buffalo and Chippewa as an excursion steamer.

J. R. Roy, resident engineer of the Dominion Government in British Columbia, who was sent up with J. L. N. Coste, the chief engineer of the Public Works Department, to examine the all-Canadian route to the Yukon, has returned to Victoria, and reports the Stickine to be a fine body of water, which steamers drawing not more than thirty or forty inches, and having powerful enough engines, may navigate for six months in the year. The trouble this season has been, he says, that several steamers with engines not powerful enough have attempted to ascend the river. The Government boat "Samson," sent to remove obstructions, could only ascend seventy-five miles.

The following have been examined by W. L. Waring, St. John, N. B., examiner of marine engineers, and passed for the following grades: O. T. Berry, St. John, third class engineers' certificate; Wm. Atkinson, Fredericton, third class engineers' certificate; G. G. Miller, Chatham, third class engineers' certificate; E. H. Haviland, Chatham, third class engineers' certificate; W. W. McLaren, Georgetown, P. E. Island, fourth class engineers' certificate; R. A. McHarg, St. John, fourth class certificate; R. S. Pendleton, Deer Island, permit; H. V. Pye, Hopewell Cape, permit; F. W. Richardson, Deer Island, permit; E. H. Strang, Lansdowne, P. E. Island, permit.

The Summer School of the Massachusetts Institute of Technology in Civil Engineering will be held at Lancaster, Mass., this year. This course in geodesy, topography and hydraulics is open to third-year men in the Civil Engineering Department. It is expected that twenty-four men, including six instructors, will attend. The work will cover, among other things, the gauging of the Nashua River below the dam, the use of the meter on the mill flumes at Clinton, the rating of the meters on Spectacle Pond, and the production of a topographical map of the vicinity of Lancaster, based on the State triangulation. Lancaster offers exceptional opportunities, not only for the work above mentioned, but also for the observation and study of the new Metropolitan Dam now being constructed, and the preparation of the basin by stripping and cleaning.

The Manchester-Canadian service is to be augmented by a new screw steamer, which has been built by Sir Raylton Dixon & Co., Middlesborough, Eng., for the Manchester Liners, Limited. Her principal dimensions are: Length over all, 461 feet; length between perpendiculars, 445 feet; breadth, 52 feet; depth moulded to upper deck, 33 feet, and to shelter deck, 40 feet 9 inches; upper bridge upon shelter deck, 128 feet long; height of upper 'tween decks, 7 feet 9 inches; height between upper and main decks, 9 feet 6 inches. The engines will indicate 4,000 h.p. and give 13 knots. The boilers, four in number, are fitted up with Howden's system of forced draught. The ship's dead-weight capacity is 8,500 tons on a draught of 26 feet 3 inches, and her measurement capacity, including bunkers, about 13,000 tons. The permanent bunkers have a capacity of 1,052 tons. The "Manchester City" is expected to be ready for sea in about six weeks, and after undergoing her steam trials she will take up the regular service between Manchester and Montreal.

Mining Matters.

W. A. Saunders is to put in another steam pump at the Golden Lode mine at South Uniacke.

A number of productive oil wells have recently been sunk in Lambton county, at Inwood, Ont.

The Calumet, Que., Mining Co., has made another rich discovery on the Upper Ottawa. It is a new mine in which is said to be nearly 40 per cent of silver.

A Wilfley concentrator is being put in by the Truro Foundry Co., at the Richardson mine at Isaacs Harbor, which will be tried on two batteries as a test.

The Bureau of Mines received a letter from Michipicoten, giving the assay of sand in the placer regions of $1.50 to $6 per ton, in gold. A ton of the sand has been shipped to the Toronto Mining School for experimenting.

The Hillsboro, N. B., manganese works, which have been temporarily closed down for two weeks on account of an accident to the machinery, have resumed operations again. The repairs to the manganese press have been made by J. Weir & Sons, Moncton.

The largest flow of oil since the Petrolea oil discovery was struck last month by Trotter and McHugh of Chatham, while boring on the Herbert farm, situated about two miles from Thamesville, Ont., in the Township of Zone. It is one of a number of wells that have been lately put down in the vicinity of Thamesville. The well when tested yielded 40 barrels per hour.

On June 18 a fire and an explosion occurred in the hoisting and compressor house of the Asbestos & Asbestic Company's works near Danville, Que. Two men were instantly killed, and one other man so badly injured that he died shortly after. The loss to the company's property is heavy, and the detention of operations will be serious, as a number of large orders were being filled. The exact cause of the explosion cannot be ascertained, though it took place by the ignition of dualine.

We observe the application for incorporation of the Eastern Townships Chrome Iron Mining and Milling Company (Limited), capital stock of $50,000, headquarters Montreal; to produce and mill gold, silver, copper, chrome iron, etc.; the parties being R. Prefontaine, M.P., J. R. Fair, Montreal; C. A. Chenevert, M.P.P., Berthierville; J. U. Gregory, Quebec; C. King, Sherbrooke, etc.

The Bureau of Mines has issued a map of the corundum belt in Eastern Ontario, and is sending out a number of circulars, containing in concise form information concerning these deposits. The corundum bearing lands have an aggregate area of 50,000 acres. The mineral rights over nearly the whole of this tract are held by the Crown, and they have been withdrawn from sale and lease pending a report on the occurrence of the mineral and the methods of treating it, undertaken by the professors of the Kingston School of Mining. This report and a map of the region will be issued shortly.

Prof. De Kolb, of the School of Mines, Kingston, has been appointed inspector of mines for Ontario by the Local Government, in place of the Rev. A. Slaght, who died a few days ago. This office is in addition to the professor's present position, as he can perform the duties during the vacation season.

A. P. Lowe, of the Geological Survey staff, Ottawa, has left for eighteen months' field work in the interior of Labrador, continuing the line which he has been engaged upon for some seasons. It has been said that gold exists in Labrador in paying quantities, and an abundance of iron and of coal in different localities.

The first general meeting of the recently incorporated Canadian Mining Institute was held in the Windsor Hotel, Montreal, June 3rd, the president, John E. Hardman, in the chair. The principal business was the establishing of headquarters, with a mining library, in Montreal. The library, which will be located in room 4, Windsor Hotel, will be stocked with books, of which the institute already possesses about 500 volumes, periodicals, papers, maps, etc., relative to mining matters. These will be at the service of those desiring to obtain information relative to the Dominion's mining resources. Reliable information will thus be disseminated. The Dominion Government has made a grant to it of $1,000. A library committee was appointed, consisting of G. E. Drummond, convener; J. Stevenson Brown, H. B. de Courtenay, the president, and B. T. A. Bell, secretary.

—The Canadian Engineer continues as interesting as ever to all engaged in metal, electrical, or mining work. It is monthly, only $1 a year, issued by Biggar, Samuel & Co., Fraser Building, Montreal, and should be in the hands of all mechanics.—Truro, N.S., Daily News.

—The members of the Toronto Astronomical and Physical Society Toronto, had an address delivered before them on "Our Atmospheric Ocean," by F. Napier Denison, June 28th. The lecturer gave the causes of air currents, dealing with special features of cyclones. He pointed out the various effects of aerial movement upon lakes and oceans, illustrating his statements by producing weather charts. The stereopticon views all through the lecture added much to its interest. Mr. Denison leaves Toronto almost immediately for British Columbia, where he will take charge of the weather forecasting department of the Observatory.

—Under the authorization of an act of the New York Legislature, that state will establish a College of Forestry. A conference has already been held at Albany to decide upon the location of 30,000 acres of land to be purchased for the purpose. No particular plot of ground has as yet been definitely picked upon. The conditions which the authorities decided upon as necessary in seeking land for the new college were formulated by Dr. Fernow, formerly chief of the forestry division of the department of agriculture at Washington, now director of the new State College of Forestry at Cornell University.—From the Railway Review.

—The results of the tests of the Roebling system of fireproof construction, in which a concrete arch, strengthened with steel rods, constitutes the floor support, will, we think, be a surprise to those who have not known hitherto the value of concrete as a fire-resisting material. That an arch of this construction of 4 ft. span, only 3 ins. thick in the centre, could support a floor loaded with 150 lbs. per sq. ft., while a fire was kept under it for five hours, reaching a temperature of above 2,300 deg. F., or beyond the melting point of copper and even of cast-iron, and then after this heating and sudden cooling by a stream of water could withstand a load of 600 lbs. without fracture, would, says the Engineering News, be considered highly improbable had it not been proved by these tests. The competitive test between an arch of concrete and one of hollow tile, in which the latter failed, is one of the most important contributions to our knowledge of the ultimate resistance of fireproof floors which has been made for many years. The manufacturers of tile floors will no doubt have something to say in their own behalf in regard to this test, for it was not an official one, but as the matter stands it looks as if the concrete men had shown that in fire-resisting qualities their construction is at least as good as that which has heretofore been accepted as the best standard construction.

—The total supply of manganese ore for the last year, for which returns are available, was 408,079 tons, and of this we in Britain used some 128,000 tons. The quantity required has been steadily increasing, being now five times what it was ten years ago. This is in part due to its more extended use in high-speed engines, where weight is more important than first cost, and where, therefore, it is preferred for its high tensile strength. It is also more largely adopted now for warships, which are wood and copper sheathed, and therefore require manganese bronze, or some other metal which will not readily corrode. The percentage of manganese is in such cases very small, usually 2 per cent. to 88 per cent. of copper and 10 per cent. of tin in engine castings. Stem and stern frames run up to 15 and 25 tons respectively, while propellers often weigh 17 tons. But withal, the extensive use is somewhat surprising, for what is known as naval brass is more in favor. The proportions for engine parts are 62 per cent. of copper, 37 per cent. of zinc, and 1 per cent. of tin. While slightly cheaper, it is, as a rule, more uniformly reliable, and the tensile strength of rods is nearly as high, usually 26 tons to 28 tons per square inch. Still, we use 128,000 tons of the ore, and pay for it the very substantial price of three guineas a ton. The metal itself costs from £80 to £100 per ton, so that only great advantage would justify its use. We have to import this ore, our native production being now under 2,000 tons, although some years ago it was 12,000 tons. That, however, was at a time when copper was dear, owing to syndicate manipulations, and then even manganese ore brought nearly £4 per ton. One-half of our supply comes from Russia, a fourth from Chili, and a considerable proportion of the remainder from France. Of the world's supply of 408,079 tons, Russia provides 240,181 tons, mined in the Ural and Southern districts, but principally in the Caucasus. Ten years ago the output was only a tenth what it now is, and the increment has been steady. Germany occupies second place, with a total of 41,854 tons, taken from the Wiesbaden and Coblentz districts close by the Rhine. The production has increased fivefold in 10 years, yet the value is only double. The price per ton has indeed declined in four years or so from about £5 to about £2 per ton. Chili comes third, due to the output of Coquimbio and Atacama, the ores from which give 50 per cent. of manganese, and for it we pay nearly £4 a ton. Their total output is about 40,000 tons, of which we take three-fourths. France has 11 mines, close to the borders of Spain, and the total has increased to 32,239 tons, but is of a low grade, the value being 30s. a ton. Japan, that land of great resource and energy, takes fifth place, and the ore is of high grade. In five years their production has increased from 945 to 13,945 tons. The United States produce 9,547 tons, got principally in Virginia, Georgia, and Arkansas states. Greece has rather decreased her proportion, the total being 9,172 tons. Turkey mined 9,000 tons, while on the borders of Austria-Hungary and Bosnia, there are deposits whence the former get 2,743 and the latter 6,484 tons. Portugal finds 6,848 tons of the world's annual supply, Spain 7,684, Sweden, 3,269, and Colombia 3,950 tons. New South Wales, New Zealand, Queensland and Canada have commenced the mining of manganese ore, and it is to be hoped the colonial supply will increase.

LITERARY NOTES.

We have received from the Association of Civil Engineers of Cornell University the volume of their transactions for 1898. The transactions make a volume of about 200 pages, illustrated by a number of interesting engravings and diagrams. Among the articles of very special importance are those on towns' water supply by E. Kuichling, C.E., and European practice in the disposal of the waste of large cities, by J. H. Furtes, Mem. Am. Soc. C.E.; the present and future prospects of gas for lighting, heating and power purposes, by Henry R. Lordly, C.E.

In 1894 there was published in New York a Canadian novel which Current Literature termed the greatest American book of the year. The New York Herald, Times and other papers paid great attention to it. The title was "The Untempered Wind," and the author Joanna E. Wood. This novel is now published for the first time in Canada by the Ontario Publishing Co. of Toronto, which house also issued in the early part of the year Miss Wood's subsequent novel "Judith Moore." Paper, 50 cents.

The Hunt cable railways for handling coal and merchandise are described in a profusely illustrated catalogue, No. 9,803, recently issued by the C. W. Hunt Co., 45 Broadway, N.Y. Among the plants of which pictures are given is the locomotive coaling plant of C.P.R. at Jackfish Bay on Lake Superior. Catalogue No. 9,806 from the same firm gives details of the automatic railways and coal elevators erected by this firm.

George H. Dobson, of North Sydney, C.B., has written a pamphlet, entitled Ocean Routes and Modern Transportation, which is worthy of consideration by the Dominion Government. Mr. Dobson argues that if Canada's ocean transport facilities had been equal to those of the United States during the past sixty years, this country would have secured a large proportion of the emigrants who went to the United States.

"The Chemistry of Paints" is a pamphlet describing the process of manufacturing white lead and paints followed in the works of Harrison Bros. & Co., Philadelphia, Penn. This firm is one of the oldest in the United States, having been in business since 1793.

The International Correspondence Schools, Scranton, Pa., has sent out a handsome pamphlet describing the origin of the schools and their present condition. A good deal of space is given to a description of the various publications of the schools which are now being issued in bound volumes.

The Herald, Halifax, N.S., has issued a forty-page pamphlet on the Canadian possibilities in Atlantic freight and passenger carrying, entitled "Ocean Routes and Modern Transportation."

We have received for review the "Pioneers of the Klondyke," which is an account of two years' police service on the Yukon by M. H. E. Haine. The book is handsomely illustrated.

THE STEAM ENGINE.

BY WILLIAM GOLDING.

If an ordinary vertical steam engine be converted into a steam elevator by removing the cross-head and putting in its place a platform which shall be loaded with bricks or other units of weight, and steam be admitted below the piston, the platform with its load will ascend; if, however, the steam be shut off when the platform has ascended one-eighth the length of the cylinder, the platform will cease to ascend. As is well known, the steam which has raised the platform through one-eighth of the desired distance, is capable of much further duty; but as the load is constant, no utilization of the steam can be effected, unless the load, in some manner, be lightened. If one brick be removed, the platform with the remaining part of the load will ascend to a point where the steam and the load again become equal; where it will remain. If another brick be removed and the operation continued, the platform will continue to ascend and convey some part of the load to the top. Now it is very certain that all of the work done after the flow of steam was cut off, was accomplished by the expansion of the original steam. And this gain or economy as usually computed is sixty per cent.; yet not one-half of the theoretical gain can be discovered in any practice, and none whatever when the load is constant.

It is usual in estimating the power of the steam engine to compute the average pressure that has been exerted upon the piston as the thrust; and to assume that this pressure has been transferred to useful work. The fallacy of computing the average pressure is illustrated in the pumping engine and the direct piston-elevator, and in the locomotive, as in all of these applications the load is constant and the initial pressure always in demand. Where the load is elastic as in the screw propeller or paddle wheel, operated by engines especially adapted to such duty, a large percentage of the average pressure on the piston may be computed. But where uniform periphery speed is required, as in a mill, the percentage of average pressure to be computed in estimating the actual power developed will be governed by the percentage of irregularity tolerated in the periphery speed of the rotary parts. In fact, if the periphery of the fly-wheel travels with absolutely perfect uniformity of speed throughout each revolution, the load is practically constant and no economy can result from expansion, no matter what point of the stroke the steam may be cut off. To maintain a uniform periphery speed of the rotary parts, it is necessary that the power be uniformly applied to each division of the circle. To this end it is suggested that the greatest measure of economy will be attained by using a cylinder with permanent cut-off for each expansion, each piston to follow at equal divisions of the circle. As in this practice the full economy of steam expansion with perfect uniformity of periphery speed and against a constant load will be attained.

The subject of the fly-wheel, as a part of the steam engine, is not generally understood; and, perhaps, more failures to give satisfaction by otherwise perfect engines may be traced to the mal-proportion of fly-wheel than to all other causes. The fly-wheel is nothing in itself. It neither produces nor consumes. It can only store power by running faster, and can only part with power by running slower. To illustrate: if a single engine is to be constructed to run a mill, and is intended to cut off one-eighth of the stroke, a very large fly-wheel will be required, in order to preserve uniform periphery speed. In this case, the pressure on the piston will vary twice during each revolution, from initial to terminal, to such an extent, that in order to insure even an approximation to uniform periphery speed, a fly-wheel of unheard of proportion would be required.

The question now arises what becomes of the initial pressure when the fly-wheel is sufficiently heavy to insure perfect rotary motion; surely it cannot be averaged with the diminishing pressure, and counted as thrust, as is the practice (per indicator). For this would necessitate the fly-wheel slowing down and starting up in speed twice during each revolution, and as the resistance is assumed to be constant, and the periphery speed absolutely uniform, the answer is that "no other than the terminal pressure can be counted in estimating the power delivered." This would be unquestionably true if the piston were thrusting a plunge into a chamber of constant resistance; or against a loaded platform, and when fully understood the conditions will be accepted as being precisely the same. Duly considering the foregoing, it cannot but be admitted that where the resistance is constant, the pressure on the steam piston must be constant. And that where the fly-wheel is sufficient in weight and velocity to maintain a perfectly uniform periphery speed, operated by an engine cutting off at any fraction of the stroke, the resistance becomes practically constant, and only the terminal pressure can be estimated as passing into useful work.

—The paper by James Milne, of Toronto, on the "Steam End of an Electric Plant," was read before the Canadian Electrical Association by C. Lord Weeks, of Toronto. Press of matter has obliged us to omit this paper from the present number of THE CANADIAN ENGINEER.

IMPULSE WATER WHEELS.*

By J. T. Farmer, Ma.E.

(Continued from May Issue).

In all these particulars there are some modifications which can be more or less exactly stated: (a) The velocity of the impinging jet is reduced in the ratio of a coefficient of velocity depending on the pipe line and nozzle. (b) Instead of striking the vane tangentially, the jet generally, as in the case particularly alluded to, strikes at a point nearer to the nozzle. (c) The force of impact is reduced owing to the velocity lost by the water in passing over the surface of the vane. Some previous experiments on this subject afford data which will be used in approximating to the loss due to this cause. (d) It is impossible, practically, to turn the water completely back on itself on account of the reaction which would take effect on the back of the succeeding vane.

In practice there will be a reduction of velocity, due to two causes: (1) Resistance of pipe line. (2) Loss in discharge from the nozzle. In the trials under discussion the heads given are those measured close to the point of discharge, so that no loss due to the pipe line need be considered. The only loss of velocity is that which occurs in the discharge from the nozzle. In the nozzles used in the experiments the stream issued from a parallel throat, and consequently there would be no appreciable contraction of the jet. The co-efficients of discharge were determined for these nozzles for heads up to 20 feet, above which point the variation becomes very slight. The results obtained therefore give an approximation to the true velocity of the jet. In addition to these determinations the co-efficient of discharge was calculated from the data afforded by each of the trials. These co-efficients agreed very closely with those obtained directly in the case of the ¾-in. nozzle. The mean values were .972 and .980 respectively. The discrepancy is not surprising when it is considered that in the former case the outflow was from the end of a long pipe, while in the latter it was from a large body of water at rest.

The discrepancy is more marked in the case of the nozzle ½-in. diameter, where the two values are .909 and .976. It is suggested that this difference is due to the fact that the interior of this nozzle was covered with rust at the time of its being used in the water wheel, as it had been in place for some time. The coating of oxide on the interior would diminish the actual area of outlet, so that the co-efficient would appear to be smaller than it actually was. In addition to this there can be no doubt that the rough surface of the oxide would diminish the velocity of the outflowing water; this may be partly the reason why the trials with the ½-in. nozzle show a smaller efficiency than those made with the ¾-in. nozzle. If this explanation is correct, it would point to the desirability of having the interior surfaces of the nozzle tips clean and free from rust. To accomplish this, it would probably be worth while to have detachable nozzle tips made of brass or some other metal not so liable to be acted upon as iron in the presence of moisture. It would also be advisable for the user to periodically take out and clean the nozzle tip, especially if made of cast or wrought iron. With a dirty nozzle there is a direct loss of efficiency corresponding to whatever loss of velocity is caused by the rough surface of the nozzle. More than this, there is a diminution in the area of the outlet, and therefore in the discharge, with the result that the power developed by the motor falls off. This may become a serious consideration if the motor is not much more than equal to the demands usually made upon it.

From calculations made it was apparent that there is still a waste of from 15 to 25 per cent. of the original energy of the water which has not been accounted for. The loss due to friction of bearings would be small in a simple machine of this sort, and the greater part of the 15 to 25 per cent. loss must be due to some departure in practice of the phenomena of action from those assumed. It is suggested that the loss arises wholly or in part from the imperfect action of the vanes or buckets in turning back the water. It will be remembered that one of the functions of the wedge was described to be to cause the water to be discharged to the side of the wheel. A little consideration, however, will show that during a part of the period of action the wedge does not perform this function. When the vane begins to intercept the jet, it is the outer lip or scoop which first comes in contact with the jet. The small amount of water which strikes the blunt edge of this outer lip is scattered, and thus only gives up a proportion of its energy to the wheel. More than this, it probably causes considerable disturbance and consequent loss of energy in the rest of the stream. As the vane passes further into the path of the jet, the water strikes on the interior curved surface of the outside scoop portion of the bucket on each side of the outer end of the wedge. The curve of the bucket at this point is such that the water is mainly deflected in an inward and backward curve in the plane of the wheel, so that it emerges from the vane surface in a plane tangential to the wheel rim; it proceeds in the same direction until it strikes the back of the following vane, producing upon it a force of impact opposite to the direction of motion of the wheel. As the wheel moves into such position that the jet plays upon the central portion of the wedge, the stream is deflected to each side in a plane parallel to the axis of the wheel, and it is then and only then, that the conditions of action assumed are approximately fulfilled. It may be estimated that the action of the water is not what it is assumed to be while the vane moves over from 1-5 to 1-3 of the total arc of action. During this interval the action of the water is more or less inefficient.

It was noticed that the deficit of the actual from the calculated efficiency increases steadily as the speed is increased. It is suggested that this may be attributed to two causes. (1) The best effect of the impact occurs when the sharp edge of the wedge is perpendicular to the line of the impinging jet. This condition only occurs at one point in the arc of action. At all other points the position of the edge of the wedge departs more or less from the perpendicular position, and the deflection does not take place in the manner assumed, with the consequence that the efficiency of the impact is more or less impaired. The higher the speed of the wheel the greater is the arc of action, and consequently the greater will be the departure of the cutting edge of the wedge from perpendicularity to the line of the jet. This would mean that the loss of efficiency of the impact is less when the arc of action is smaller, or the speed small, and that the loss of efficiency increases as the arc of action increases, or as the speed is increased. (2) It was pointed out how the action of the outer lip or scoop at the beginning of the arc of action tended to impair the efficiency of the wheel. It will be seen that if the arc of action is large enough the same effect will take place at the end of the arc of action, as well as at the beginning. If, therefore, the speed is increased to such an extent as to allow this to occur, there will be a further cause of loss of efficiency at high speeds.

It is estimated that the efficiency would not suffer diminution from this latter cause until the velocity reaches a value of 800 revolutions per minute with the 175 foot head, or a value of 900 revolutions per minute with the 235-ft. head.

I.—Nozzle .5277 in. Diameter. (a) Pressure 50 lbs. per sq. inch. Equivalent head = 115 feet. Discharge = 45 gallons per second:

---

*From a Paper read before the Canadian Society of Civil Engineers.

Speed.	Horse Power.	Efficiency.
252	.79	50.7
322	.76	48.5
398	.93	59.1
400	.86	57.0
407	.84	53.5
438	.87	56.7
450	.94	59.9
497	.96	62.8
506	.94	60.4
545	.95	60.6
551	.95	61.0
565	.84	55.7
585	.76	47.3
588	.83	52.6
625	.91	55.7
638	.91	58.3
665	.83	52.2

(b) Pressure 75 lbs. per sq. inch. Equivalent head = 175 feet. Discharge = 53 gallons per minute.

Speed.	Horse Power.	Efficiency.
345	1.38	49.8
409	1.52	54.9
477	1.68	60.7
523	1.68	61.4
582	1.80	64.7
594	1.79	65.8
632	1.75	64.4
632	1.76	63.1
672	1.78	64.1
677	1.56	55.3
725	1.63	58.3
726	1.65	59.6
737	1.61	59.7
768	1.55	55.1
779	1.57	57.0
847	1.40	51.2
879	1.31	47.7

(c) Pressure 100 lbs. per sq inch. Equivalent head = 235 feet. Discharge = 63 gallons per minute.

Speed.	Horse Power.	Efficiency.
276	1.70	37.9
306	1.85	41.2
345	1.98	44.4
387	1.90	44.5
459	2.22	49.7
470	2.36	52.8
541	2.52	56.0
605	2.67	60.0
644	2.80	63.2
698	2.76	64.0
760	2.96	65.0
834	2.65	59.5
858	2.78	61.8
914	2.76	58.6
939	2.76	57.9

(d) Pressure = 125 lbs. per sq. inch. Equivalent head = 290 feet. Discharge = 70 gallons per minute.

Speed.	Horse Power.	Efficiency.
494	3.25	52.0
536	3.32	53.6
592	3.50	57.5
664	3.79	62.1
702	3.83	63.3
765	4.00	65.2
813	3.89	62.8
867	3.93	64.8
918	3.95	64.0

(*Continued in next issue.*)

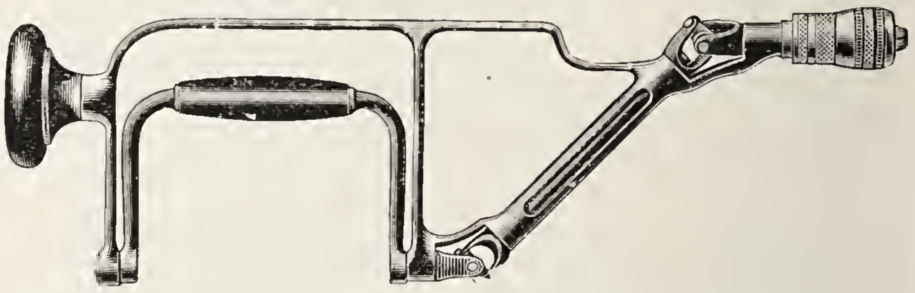
The Geo. White & Sons Co., Ltd., manufacturers of agricultural implements, London, Ont., have completed the new building, 175 x 35 ft., in which it is intended to manufacture threshing machines under rights bought recently from McPherson & Co., Fingal, Ont.

The Hamilton Facing Mill Co. have been running overtime for some months past, and have not been so busy for years as they are now.

The Garlock Packing Co., of Hamilton, have had a very busy season. Among the specialties this company is turning out is a high-grade asbestos covering which is meeting with wonderful success all over the country. The Garlock Packing Co. have won the confidence of engineers and steam users, and this no doubt is one reason why their new line of goods has come into favor so quickly.

THE UNIVERSAL BRACE.

The universal brace needs but little explanation with the practical mechanic, whether he be electrician, plumber, or carpenter; it is rapidly crowding out of the market the old-fashioned and clumsy angle brace, so long the only article of its kind obtainable. The tool is usually supplied with a bar grip handle, which is specially adapted for overhead and horizontal work. The Aikenhead Hardware Co., 6 Adelaide St., East, Toronto, will be pleased to answer all enquiries as to price, etc., of this very necessary article.



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ERROR IN DRAINAGE PRACTICE.

BY W. M. WATSON.

A person living in a house that was subject to a foul odor reported the nuisance to the town's medical officer, who sent at various times each member of his staff to investigate, and they each laid the blame on the plumbing and sanitary appliances used in the house, but when an experienced sanitary plumber was engaged he looked for another cause to account for the smell, and after using pick and shovel for a few hours, he put on exhibition the reason for the foul odors, which, as usual, was the blocking of the house trap and settlement of the new drains, causing the dumping of the sewage from all the fixtures in the house into the soil under the kitchen.

Another similar, but more serious example of the many hidden dangers, I propose to relate here, showing the evils of using too many drain traps and using drains of too large a size. I was engaged to find out the cause of foul odors pervading the basement of a large factory. There were water closets, urinals and slop sinks on three of the four flats, each and all delivering into one 4-inch soil pipe extending from the drain underneath the floor to above the roof of the factory. Then every fixture was back-vented into a 3-inch cast iron pipe commencing at the basement floor and passing through each story and terminated above the roof. The plumbing and fixtures were of a high class, and well put together, but when some digging was done below the basement floor and the drains and discharge end of the 4-inch soil pipe were exposed to view, it proved that very little, if any, of the stuff coming down the soil pipe had found its way to the street sewer because the careless way the soil pipe was connected to the tile pipe drain made it almost impossible for it to do so, except at a time when there was a heavy rainstorm or when a large amount of liquid was discharged down the interior drains. Fig. 2 is a sketch showing how the drain and soil pipe were connected when found, leaving out the branch that served the basement water closets and which should be shown to join the horizontal piece of soil pipe between the two bends, immediately before it joins the tile pipe. There was a 9-inch tile-pipe drain from the street sewer to about 7 feet inside the building, laid almost at a dead level, including the trap and T pipe, then a 6-inch drain commencing with a hand-hole running trap intended to keep back the sewer gas from all the other parts of the building. This pipe passed under the factory floor for the full length of the factory, with branches to each rain water leader and slop water gully in the yard, having a grade of only about 1 in 100, and clayed joints. The total length of the 6-inch pipe laid under the floor would be over 100 feet, which would be equal to a storage tank holding about 140 gallons. The 9-inch trap would hold about 40 pounds of water, and the water in the T pipe would have to be 1 inch deep before it could in any way move such a bulk of water as rested in the 9-inch trap, and then the liquid only would be able to get round the dip, while the solids would stay in the dip of the trap and choke it. The largest flush a soil pipe would discharge at one time would be 3 gallons, under 30 pounds in weight, and in this case it discharged vertically through a square T, striking the opposite side or bottom of the 9-inch pipe. The sewage then had liberty on account of the drain being level to choose its own road, and of course preferred the easiest, which was to pass backward through the 6-inch trap that only holds about 20 pounds of fluid or half the amount of a 9-inch trap, which would be soon choked and blocked up with solids. The drains being nearly level throughout their whole length they would hold about 50 gallons of sewage in store before a reaction would take place, even if the 9-inch trap was free, and the fluid begin to dribble outwards towards the street sewer. The 50 gallons would therefore generally be lodging in the pipes or wasting away through the defective joints in the sewer pipes and contaminating the sub-soil under the planked floor. The excrements and paper of sewage will, if well distributed among the fluid, dissolve into a liquid in a few days, so that when there is a space, as there was at this factory equal to 50 gallons, acting as a storage and liquefying chamber, they may continue to dispose of the excrements for a number of years through leaking joints and never have a real choke to enable the owners to find out what hidden damage is done to the building and inhabitants. A 4-inch soil pipe can never flush the sewage it delivers through 9-inch pipe traps, because it is about five times larger than the 4-inch soil pipe. The fluid coming down the soil pipe will pass through the largest trap only by soaking through slowly, devoid of any carrying force, which makes it nearly impossible to carry down any substance heavier than water. Therefore to put in a 9-inch tile trap to serve a 4-inch soil pipe is about the same as plugging up the end of the drain to prevent anything passing through to the street sewer. The 9-inch drain was too large for the work, but it might answer if the soil pipe was made to enter as shown in Fig. 1, and the trap dispensed with, which was unnecessary in this case, and not demanded by any town by-law.

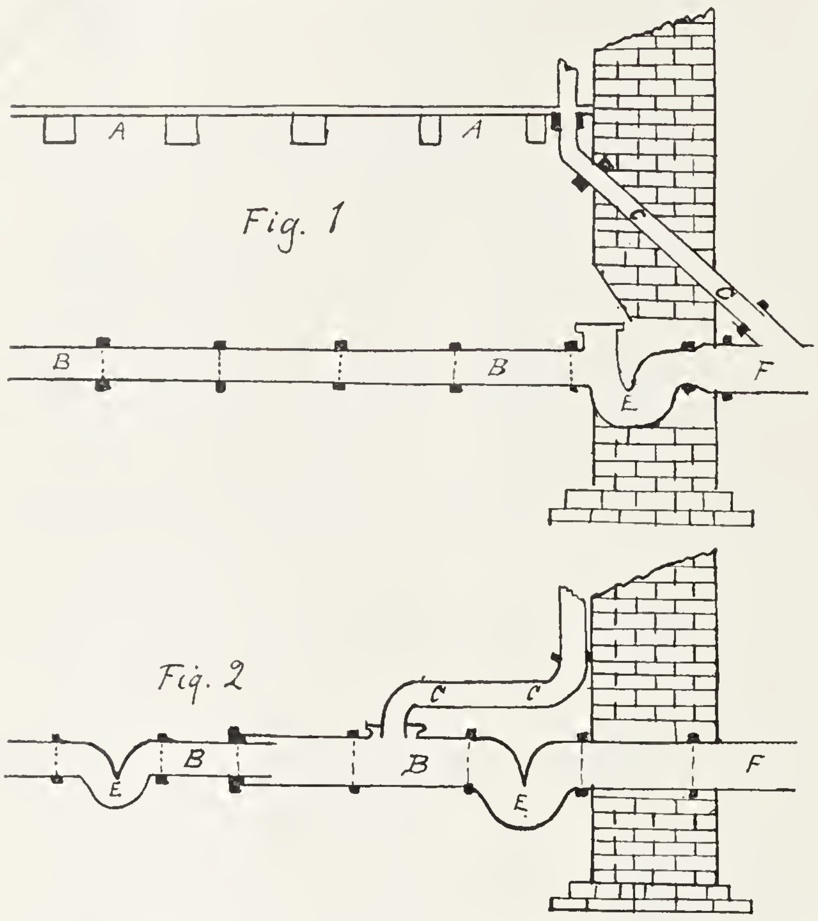


Fig. 1—Plumbing arranged in a satisfactory manner. Fig. 2—Plumbing as actually installed. A A—Factory floor. B B—Tile drain below floor. C C—Soil pipe. E E—Traps. F F—Street drain.

When drains are almost level and in a position as found in this factory, it would be much better and safer to have a reflex flag valve in behind the soil pipe and near the trap, to prevent excrement backing under the factory or the sewage coming back when the flood occurs. No doubt the idea of laying the 9-inch portion of the drain was to leave plenty of room for the contents of the soil pipe when the 6-inch drain was delivering the storm water at full bore, but it was not necessary on that account, because the soil pipe would only deliver occasionally, and then only about three gallons at one time, and that small amount would have very little effect on a stream passing through a 6-inch pipe, and a good rush and flush four times in a year, which is as often as an extra large rain storm comes. When the plumber who did the work, when newly erected, saw the square T junction and 9-inch pipe to connect his 4-inch soil pipe to, he ought to have declined to join the drain in that way. And if his instructions were imperative that the soil pipe should have an intercepting trap and breather, he might have attached a 6-inch, or, better still, a 4-inch hand-hole trap and breather pipe, and after connecting them the pipe might have been coupled to the line of 9-inch drain pipes by a side junction. By making this mistake a large amount of expensive first-class work was rendered dangerous by the error of connecting the soil pipe into the square T junction, and behind a useless 9-inch interception trap, as shown in Fig. 2.

—A correspondent, who is a member of the Canadian Electrical Association, writes to express his admiration of the electrical and mechanical experimental plants at McGill University, Montreal, and to convey the thanks of himself and friends for the courtesy shown by the faculty on the occasion of their visit during the recent convention. Our correspondent was particularly struck with the clearness and simplicity of the answers given by Dr. L. A. Herdt to every question asked by the members when visiting the electrical laboratory. This faculty in Prof. Herdt has struck many others since his connection with McGill. To possess a profound knowledge of a subject and to be able to impart this knowledge in a way that a learner can clearly understand, is a combination of gifts possessed by few. The record which this young professor has already made, both as a practical electrician and an investigator, indicates a most promising future for him, and it should be a peculiar satisfaction to McGill to have a native-born Canadian of such talent at the head of its electrical department.

RESULTS OF EXPERIMENTS ON THE STRENGTH OF WHITE PINE, RED PINE, HEMLOCK AND SPRUCE.[*]

BY PROF. H. T. BOVEY, LL.D., D.C.L.

In a paper read before the Canadian Society of Civil Engineers, in 1895, the results were given of a number of experiments on the transverse strength of timber beams; but in the calculations it was assumed that the distortion, or diminution of depth at the bearing surface, was sufficiently small to be disregarded. It often happens, however, and especially when the timber contains a large amount of moisture, that the change in depth due to compression is excessive, producing a corresponding increase in the skin-stress. The method of conducting these experiments was fully described in the paper referred to, and therefore the following points only are noted:

All the transverse tests were made with the Wicksteed machine. The middle of the beam was supported on a hardwood bearing of 44 inches diameter. The two ends were forced down by rams under hydraulic pressure, which can be gradually increased at any required rate, or can be maintained constant for any given time. The end-pressures were kept normal to the surface of the beam by means of spherical joints, which allow the end bearings to revolve. In previous experiments, the wire used in observing the deflections was found to be somewhat coarse, and a special wire was therefore drawn of .002-inch diameter.

The flexure theory is admittedly unsatisfactory, and frequently gives results which are contrary to experience. Possibly, when a certain limit has been passed there is a tendency towards equalization of stress, and the so-called neutral surface may be moved towards that portion of the beam which is best able to bear the stress. It may indeed be more correct to assume that the distances of this surface from the tension and compression faces are in the ratio of the ultimate tensile and compressive strengths of the beam. This assumption at all events seems to give results which are more in accordance with practice. For example, in the case of a cast-iron Tee bar, tested in the University Laboratory, the tensile skin-stress should be 22,030 lbs. per sq. inch, and the compressive skin-stress 102,050 lbs. per sq. inch, wheras the ordinary theory gave 33,000 lbs. per sq. inch as the tensile and 20,800 lbs. per sq. inch as the compressive skin-stress.

The following tables give the breaking weights, skin-stresses, (transverse), coefficients of elasticity and specific weights of a number of air-dried, saturated, frozen and kiln-dried beams.

---

[*] Extracted from a paper read before the British Association for the Advancement of Science, Toronto, 1897.

TABLE I.

White Pine From Ordinary Stock.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity in lbs. per sq. in.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.	*E.*		Centre.	Left end.	R't end.	
15	186	6.225	15.2	23,850	5,021	4,777	4,889	1,296,950	36.43	......	......	......	Crippled.
16	186	6.32	15.25	22,690	4,774	4,480	4,627	1,359,050	38.64	......	......	......	Longitudinal shear.
28	138	9.1	15.21	39,000	4,403	4,018	4,210	1,078,230	27.121	17.29	12.89	13.21	Longitudinal shear.
32	186	6.025	12.25	16,000	5,531	5,153	5,342	1,368,500	27.983	28.262	27.014	27.274	Crippled.
46	186	5.725	5.9	5,200	8,967	7,312	8,389	1,625,220	23.794	......	......	......	Crippled.

TABLE II.

White Pine Dried at 212° F.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	*E.*	Sp. wt.	Centre.	Left end.	R't end.	Character of failure.
36	150	5.95	11.925	......	2,201	2,164	2,182	1,245,780	22.007	......	......	......	Tensile.
38	75	2.965	5.925	5.000	5,911	5,569	5,740	1,272,440	22.105	......	......	......	Crippled.
42	150	5.7	5.9	8,000	9,538	9,247	9,392	1,282,770	20.674	......	......	......	Tensile.
43	150	6.05	11.725	23.000	9,992	7,091	8,542	1.171,240	22,648	......	......	......	Tensile.

Beams 15 and 16 were sawn out of trees felled at Keewatin in 1894, and were received into the Laboratory on the 13th of December, their weights being 415.75 lbs. and 457.78 lbs. respectively. They were both tested on the 2nd of February, 1895, when it was found that beam 15 had lost 36.69 lbs. or 8.8 per cent. of its weight, and that beam 16 had lost 46.59 lbs. or 10.2 per cent. of its weight. When the beams were sawn through after the test they were still found to be completely saturated with water excepting for a depth of 1 inch from the surface. The beams were from the central portion of the trees, the heart running from end to end. Beams 28 to 43 were sawn from trees felled in water, 1893—4, in Quinze Lake Co., P.Q. They remained in water one year, and were received into the Laboratory on October the 4th, 1895. They were all first quality timber, and, generally speaking, straight in grain and free from knots and shakes. In order to determine the excess of moisture in the timber, three slabs, one near the middle and one at each end, were sawn out of the beams immediately after they had been tested and were at once placed in a chamber kept at a temperature of 212° F. by steam-pipes. The moisture was also removed from the whole beams by drying them in the same chamber. Beam 36 failed suddenly under a very small load, the fracture commencing at a knot in the tension surface. On exam-

TABLE III.

Red Pine From Ordinary Stock.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.			Centre.	Left end.	R't end.	
17	186	6.15	15.2	21,350	4.531	4,322	4,426	1,252,700	32.279	......	......	......	Crippled.
18	180	5.75	15.0	21,730	4.589	4,466	4.527	1,351,350	......	......	......	......	Crippled and longitudinal shear.
31	186	5.975	12.275	23,400	7,840	7,469	7,654	1,814,190	35.95	17.38	16.9	12.94	Longitudinal shear.
45	186	6.025	6.025	7,600	10,034	9,871	9.952	2,768,630	37.144	......	......	......	Crippled.
49	188	5.75	14.925	22,700	5,240	5.100	5,170	1.669,010	30,592	8.8	8.7	8.1	Longitudinal shear.

TABLE IV.

Red Pine Dried at 212° F.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt.	Centre.	Left end.	R't end.	Character of failure.
37	150	5.75	11.875	21.000	6,160	5,953	6.056	2,049,430	30,072	......	......	......	Longitudinal shear.
41	150	5.885	5.925	8,800	9,572	9,472	9,522	2,261,820	30.858	......	......	......	Tensile.
44	150	5.875	11.785	20,000	5,732	5,617	5,674	2,219,550	34,038	......	......	......	Longitudinal shear.

ination it was also found that the grain on the face was oblique to the neutral surface, while there were shakes running from end to end in the neighborhood of the heart which, on the average, was below the middle of the depth of the beam. The results of this test should be discarded, as the beam was not of fair average quality. Beam 38 was cut out of beam 36 in such manner that the grain was straight.

Beam 43 failed under a breaking load of 23,000 lbs., but a somewhat long continued and slowly increasing deflection under a load of 22,000 lbs. seemed to indicate that at this point the beam failed in compression, although there were no apparent signs of crippling.

TABLE V.

Hemlock From Ordinary Stock.

No. of Beam.	Dimensions in inches.			Breaking weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft.	Per ct. of weight lost when dried at 212 deg. F.			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.						
25	222	8.815	10.1	13,000	5,132	4,995	5.063	1,581,710	53.025	50.43	39.93	47.85	Crippled.
26	186	8.975	10.015	20,000	6,615	6,371	6.493	1.498,640	36.533	......	......	......	Crippled.
29	186	9.85	11.95	20,040	4,133	4,058	4,096	883,291	36.235	34.6	......	......	Tensile.

TABLE VI.

Hemlock Dried at 212° F.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft.				Character of failure.
40	87	4.35	4.925	3,500	7,946	5,054	6,500	1,379,860	31.346	......	......	......	Longitudinal shear.

TABLE VII.

Hemlock Saturated and Frozen.

No. of Beam.	*l.*	*b.*	*d.*	Breaking weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft.				Character of failure.
22	138	9.0	11.875	30,800	5,393	5,166	5,280	1,174,700	38.69	......	......	......	Tensile.
23	138	9.025	11.9	21,000	3,482	3,450	3,466	1,242,150	45.23	......	......	......	Tensile.
35	190	9.175	10.05	22,000	7,188	6,960	7.074	1,633,050	50.707	51.07	49.75	57.42	Crippled.

Remarks.—Beams 17 and 18, containing the heart, were cut from trees felled at Keewatin in 1894, and were ordinary 1st-quality timber. There were shakes in beam 17, reaching the heart at points. The grain on the lower half of the beam was straight, but ran cross-wise on the tension surface. From the time the beam was received into the Laboratory to the date of the test, a period of 57 days, the beam lost 13 per cent. of its weight. After the test a 3-inch slab was cut out, and the weight of this slab on Feb. 15th, 1897, by which time the natural drying can be considered to have been completed, was found to be 28.037 lbs. per cubic foot. Beam 18 was tested after remaining in the Laboratory 42 days, in which time it was found to have lost 8.79 per cent. of its weight. It failed by crippling and longitudinal shear, simultaneously. The grain for about 10 inches

TABLE VIII.

Spruce From Ordinary Stock.

No. of Beam.	Dimensions in inches			Breaking. weight in lbs.	Skin stress (f) in lbs. per sq. inch.			Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Per ct. of weight lost when dried at 212 deg. F. at			Character of failure.
	l.	*b.*	*d.*		Max.	Min.	Mean.			Centre.	Left end.	R't end.	
24	222	9.175	10.1125	15,800	6,208	5,846	6,027	1,629,050	32.307	26.7	24.7	27.3	Crippled.
27	186	8.725	10.025	14,600	4,899	4,758	4,829	1,458,360	29.354	......	......	......	Crippled.
30	186	8.725	11.875	15,900	3,758	3,682	3,720	2,020,300	30.603	11.1	......	......	Longitudinal shear.

TABLE IX.

Spruce Dried at 212° F.

No. of Beam.	*l.*	*b.*	*d.*	Breaking. weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Centre.	Left end.	R't end.	Character of failure.
39	78	3.775	4.35	5,800	9.774	9,603	9,689	2,373,080	31.606	......	......	......	Longitudinal shear.

TABLE X.

Spruce Saturated and Frozen.

No. of Beam.	*l.*	*b.*	*d.*	Breaking. weight in lbs.	Max.	Min.	Mean.	Coefficient of elasticity.	Sp. wt. in lbs. per cub. ft. at date of test.	Centre.	Left end.	R't end.	Character of failure.
33	186	9.2	10	14,000	7,212	6,887	7,050	2,373,080	39.78	30.618	33.55	......	Crippled.

on each side of the centre was clear, straight and free from knots. The logs from which beams 31 to 49 were sawn were felled in the Bonnechere district in the winter of 1894—95, and remained in the water for six months. They all contained the heart, and were ordinary 1st-quality timber. Beam 32 failed by longitudinal shear along a shake in the neighborhood of the neutral surface, but there were indications that this had been immediately preceded by a slight crippling.

Remarks.—Beams 22, 23 and 35, containing the heart, had lain in the water for a considerable time, and were completely water-soaked. When tested, beams 22 and 35 were found to be hard frozen. Beam 23 was also frozen, but not throughout, as was shown when the beam was cut in two at the centre. Beam 22 was straight-grained, free from knots, and failed with a sudden sharp fracture. Incipient decay had commenced near the heart of beam 23, which, however, was regarded as a fair specimen of ordinary commercial quality. It was full of large knots and the grain was curved from end to end. Beam 35 was straight-grained, clear, comparatively free from knots and of exceptionally good quality; beam 40 was cut out of beam 35 after the latter had been tested. Beams 25, 26 and 29 all contained the heart. Beam 25 was a good specimen, and was completely water-soaked. Beam 26 was saturated throughout, excepting for a depth of 1½ inches from surface, and, although an apparently poor specimen, was considered to be of ordinary commercial quality. It was full of knots and its grain was curved.

Remarks.—Beam 24 was wet, but was in good condition and comparatively free from knots. Beam 27 was of ordinary commercial quality, with fairly straight grain and a large number of small knots. Beam 30 was of ordinary commercial quality, but with large shakes running from end to end and dividing the beam practically into four sections. Beam 33 was water-soaked and hard frozen when tested. It was of exceptionally good quality, free from shakes and had clear, straight grain. Beam 39 was cut out of beam 33 after the latter had been tested.

In the transverse experiments the greatest possible care was taken to increase the load at the same uniform rate, the average time occupied in adding each increment and in taking the corresponding reading being slightly greater than 1 minute. In many cases the beam was loaded, then relieved of load, and reloaded again, the readings in all cases being carefully noted. This operation was sometimes repeated more than once. Whenever a beam or a specimen under tension or compression was subjected to repeated loadings, the first series of readings were almost invariably discarded as the increments of deflection, and changes of length were found to be more uniform after the preliminary loading. The initial loading seems to eliminate certain inequalities of resistance.

In beam 15 there was an increment of .401 inches in the deflection, corresponding to an increment of 7,000 lbs. in the load. On reducing the load to 500 lbs., there was an apparent set of .006 inches, which would have undoubtedly disappeared in a short time. Upon reloading the beam, the increment of deflection for the same increment of load was .4 inch. In beam 17 the increments of deflection under the first and second loadings were exactly the same, viz., .415 inch for an increment of 7,000 lbs. in the load. When the load, after the first series of readings, was reduced to 500 lbs., there was an apparent set of .005 inch, which would have certainly disappeared had the beam been allowed to rest for a few minutes. In beam 24 (Spruce), for an increment of 6,000 lbs. in the load, the increment of deflection was 1.04 inch in the first loading and 1.034 inch in the second. Upon being entirely relieved of load, there was an apparent, but evidently only apparent, set of .01 inch. In beam 25 (Hemlock), for an increment of 6,000 lbs. in the load, the increment of deflection was 1.165 inch in the first loading and 1.155 inch in the second, the apparent set when entirely relieved of load being .01 inch. In beam 27 (Spruce), after being loaded and then entirely relieved of load, there was an apparent set of .005, which in two hours had fallen to .002 inch. In beam 26 (Hemlock), after being loaded and then entirely relieved of load, there was an apparent set of .004 inch which had entirely disappeared after an interval of about two hours.

In the case of beam 28 (White Pine), there were three sets of loadings, the increments of deflection corresponding to an increment of 12,000 lbs. in the load being: .238 inch and .234 inch for the first set, .237 inch and .232 inch for the second set, .237 inch and .232 inch and .232 inch for the third set.

When the beam was entirely relieved of load after the first set, there was an apparent set of .002 inch, which had entirely disappeared in 25 minutes. The second set of loadings commenced after an interval of 18 hours. The mean increment of deflection=.2344 inch; the mean compression=.0827 inch, and, using the ordinary formula, the corresponding value of E=1,066,980 lbs.

The increments of deflection for repeated loadings corresponding to an increment of 6,000 lbs. in the load were: .675 inch, .660 inch, .650 inch, for beam 29 (Hemlock), .335 inch, .330 inch, .337 inch for beam 30 (Spruce), .492 inch, .485 inch, .487 inch for beam 31 (Red Pine), .675 inch, .655 inch, .653 inch for beam 32 (White Pine), .313 inch, .308 inch, .305 inch for beam 49 (Red Pine).

The increments of deflection for repeated loadings, corresponding to an increment of 7,000 lbs. in the load, were: .625 inch, .620 inch, .620 inch, .625 inch for beam 33 (Spruce). The increments of deflection for repeated loadings, corresponding to an increment of 5,000 lbs. in the load, were: .590 inch, .556 inch, .555 inch, for beam 35 (Hemlock).

For beams dried at 212° F., the increments of deflection for repeated loadings were: .420 inch, .400 inch, .405 inch, .405 inch, .405 inch for beam, 36 (White Pine), and an increment of 6,000 lbs. .178 inch, .173 inch, .173 inch, for beam 37 (Red Pine), and an increment of 4,000 lbs. .039 inch, .042 inch, .040 inch, .040 inch, for beam 38 (White Pine), and an increment of 300 lbs. .048 inch, .048 inch, .048 inch, .049 inch for beam 39 (Spruce), and an increment of 300 lbs. .071 inch, .070 inch, .070 inch, .070 inch for beam 40 (Hemlock), and an increment of 300 lbs. .363 inch, .358 inch, .358 inch, .363 inch for beam 41 (Red Pine), and an increment of 1,200 lbs. .669 inch, .672 inch, .675 inch for beam 42 (White Pine), and an increment of 1,200 lbs. .411 inch, .416 inch, .408 inch, .402 inch for beam 43 (White Pine), and an increment of 6,000 lbs. .243 inch, .240 inch, .238 inch, .241 inch for beam 44 (Red Pine), and an increment of 6,000 lbs.

From these results and from the further observations up to the point of fracture, the following inferences may be at once drawn: (a) The increment of deflection diminishes and therefore the coefficient of elasticity increases with the elimination of the moisture from the beam. (b) The increments of deflection are much more uniform in amount in the case of kiln-dried beams.

It is, of course, impossible to maintain a beam in a kiln-dried state. As soon as it is exposed to the atmosphere, it at once commences to absorb moisture, and the absorption continues until there is an equilibrium between the hygrometric conditions of the beam and atmosphere. The beam is then in its normal state, and the experiments indicate that the increments of deflection, corresponding to this state, are approximately uniform. The rate of absorption depends essentially upon the nature of the timber, and proceeds more slowly as the density increases. The weight of a central 2-inch slab of beam 30 (Spruce), increased 3.6 per cent. in 24 days, and 8.5 per cent. in 47 days. The influence of moisture on the deflection of a beam was well illustrated in the case of 15 inch x 6 inch Douglas fir beam on 186 inch centres. On June 15th, 1895, it was placed in position and was loaded with a weight of 1,000 lbs. at the centre, producing a deflection of .071 inch. The daily observations, extending over several months, showed a continually increasing deflection, until, by the evaporation of the moisture, the beam had attained its normal state. The average deflection now remained constant, varying, for example, between .09 inch on August 24th, and .082 inch on September 2nd, the greater deflection of course corresponding to an increase of moisture in the atmosphere. On the 4th of September, the load was increased to 2,000 lbs., which produced a deflection of .127 inch. This load remained on the beam until January 8th, 1896, the deflection during the same period varying between .129 inch and .114 inch.

Of 20 non-kiln dried beams, 11 failed by crippling on the compression side, 6 failed by longitudinal shear, and 3 hemlock beams only failed by the fracture on the tension side. The experiments on the direct tensile and compressive strength of the timbers show that this is precisely what might be expected to take place. In every case the direct tensile strength is very much greater than the direct compressive strength, and failure by crippling is likely to take place under a load much less than the material could bear in tension. Under all circumstances, therefore, in practice, it is advisable to place a beam so that the portion of the timber which is strongest and in the best condition should be in compression. Again, the experiments conclusively show that kiln-drying enormously increases the direct compressive strength, but greatly diminishes the shearing strength, while the direct tensile strength does not appear to be much affected, although in the majority of cases it was diminished, and sometimes considerably. The large increase of strength in compression due to kiln-drying might have been naturally expected, as in the process of drying the walls of the cells are stiffened and hardened, and thus become better able to resist a compressive force. The walls, however, are at the same time much more brittle, and it is possible that a sudden blow might cause the failure of a kiln-dried column, which would have remained uninjured had the moisture not been eliminated. It may also be of interest to note that in the re-tests of specimens after the injured portion had been removed, the compressive strength was, almost without exception, increased. Hence, by kiln-drying a beam its compressive strength is made to approximate more closely to its tensile strength, and its transverse strength is consequently sometimes considerably increased. It must be remembered, however, that this kiln-drying invariably largely diminishes the shearing strength, and therefore proportionately increases the tendency to shear longitudinally. Thus, of the nine kiln-dried beams in the preceding tables, only one failed by crippling while four failed by fracture on the tensile side and four failed by longitudinal shear. Indeed, generally speaking, kiln-dried beams will fail either by a tensile fracture or by a longitudinal shear, and this result has been further verified by experiments subsequent to those referred to in the present paper.

In practice, of course, beams cannot be maintained in a kiln-dried state, but they rapidly pass into the normal state. The question of how far it is desirable to eliminate the moisture depends essentially on the balance to be maintained between the tensile, shearing and compressive strengths, and a beam should always be placed so as to exert its relative strength to the best advantage. Kiln-drying, unless some special method of prevention is adopted, develops shakes in the timber and causes existing shakes to become more pronounced. Some of these shakes often extend to a great depth and run the whole length of the beam, so that it not infrequently happens that only a slight layer is left to hold the beam together. Such a beam, although otherwise sound and clear, offers very little resistance to longitudinal shear, and might more justly be regarded as being made up of two or more superposed beams.

When this paper was read by Prof. Bovey before the Canadian Society of Civil Engineers, the following discussion ensued:

Prof. Bovey replying to a question stated that the direct tensile strength of timber is much greater in every case than the direct compressive strength, for instance, if 10 represented the tensile strength, 5 would represent the compressive, and for that reason, as his experiments showed, it was always best and safer to put the best side of the timber in compression.

Mr. Peterson replied that while Prof. Bovey's tests indicated that the failure usually took place on the compression side he found that in actual practice the timber invariably failed on the tension side, therefore, he maintained, the direct compressive strength of timber is greater than the direct tensile strength.

Prof. Smith said incipient failure having occurred on the compressive side the neutral axis shifts its position and throws an additional strain in tension.

Prof. Bovey.—A beam which had apparently failed on the tension side, had in reality been first weakened by crippling in compression (which is not always visible), and this threw an additional strain on the tension side, which thereupon ruptured first. No two pieces of timber give the same results, they vary greatly, e. g., if you can cut a piece of timber into three parts longitudinally you will find they vary largely, as far as strength is concerned.

Mr. Irwin pointed out that after a timber had failed the part injured in compression would return so as to escape observation easily, whereas an actual rupture gradually took place on the tension side.

Mr. Peterson said, speaking of bridge trusses, that he had never known the top chord to fail, and that it was not nearly so liable to do so as the bottom chord, therefore it does not coincide with the experiment made.

Prof. Bovey replied that the cases of a bridge truss and a beam of timber were not parallel, and that the top chord of a bridge truss was subject to direct compressive strains very different to those in a beam under the load.

Mr. Duggan remarked that a bridge truss never failed in the solid, but only in the joints, these being the weakest points.

PROGRESS OF CALCIUM CARBIDE.

The manufacture of calcium carbide has been making steady and rapid progress during the past year, and it is satisfactory to note that as the discoverer of the first commercially successful method of production is a Canadian, Canada now takes the lead in its manufacture. In our issues of January, 1896, February, 1897, and January, 1898, as well as in other numbers, historical and technical descriptions were given of the manufacture of calcium carbide and its product, acetylene gas, along with a biographical sketch of the discoverer, Thomas L. Willson, now head of the Willson Carbide Works Company, of St. Catharines and Merritton. A visit of a representative of this journal to the works at Merritton shows that the manufacture of carbide has greatly developed since our last report. There are now three power stations, producing a total of 1,500 h.p. and operating six furnaces, which are running night and day. The export of calcium carbide from these works had last year risen to $22,000, but this year the output will be $50,000, and it only requires sufficiently large factories to multiply this production by ten. That Mr. Willson has always had a most complete faith in the future of acetylene may be inferred not only from what has appeared in these columns from time to time, but from the fact that he ventured an outlay of $250,000 when as yet the character of the public reception of acetylene was a problem. It is no longer a problem, however, for Canadian calcium carbide is now being shipped to the remotest ends of the earth. On the day our representative called a shipment was being made to Hong Kong and another to Shanghai, while just before that a large shipment had gone to South Africa. Two carloads per month now go regularly to New Zealand, while three shipments had been made to the Klondyke, and an offer had just been received from Dawson City for 100 tons to be forwarded immediately. A single firm in Manitoba takes 42 tons per month. The consumption is increasing in each province of Canada and little by little the insurance companies have yielded up the prejudices that existed before the character of acetylene gas became so well known. Recently the Underwriters' Association of Toronto abolished the extra premium of 10 per cent. which had been charged against users of acetylene gas. One remarkable recent development in this gas is its extensive use for bicycle lamps. For use in this line of lighting alone three car loads were recently ordered by one Canadian firm, and this consignment was expected to be exhausted in two months. In Toronto, where cyclists are not compelled to carry lamps at night, there is comparatively small consumption for this purpose, but in Montreal, where the city by-laws require each wheelman to carry a lamp at night, the popularity of the acetylene bicycle lamps is remarkable. The contrast between an acetylene and oil lamp is very striking. The oil lamp, which is only used by about one out of five in Montreal, makes a very dismal gleam by the side of the acetylene gas lamp. Four ounces of carbide will last seven hours in a bicycle lamp, the carbide being retailed at 25 cents for a 2½ pound can. The cost varies from ½ a cent. to 1 cent per hour, and apart from the brilliancy of the light a charge will last much longer than a charge in an oil lamp. Some very convenient students' lamps are now being put on the market for acetylene, while its use for domestic lighting generally is steadily increasing. We have before referred to the fact that the explosive power of acetylene gas in gas engines is much greater than that of oil or gas. While of ordinary gas 18 to 20 cubic feet are required to produce a horse-power, the same power can be obtained from 5 cubic feet of acetylene gas. Acetylene therefore yields about four times the power of other gas. To put the question in another shape. a great saving of space and weight can be gained by the use of acetylene gas engines, and for light power these engines can be built so small as to be practically noiseless, As compared with coal a given power can be obtained from about one-seventh of the weight of carbide. That is to say, where about seven pounds of coal are required per horse-power, one pound only will be needed of carbide, a pound of the carbide producing five cubic feet of gas. The explosions from acetylene are quicker than from coal gas or oil, and consequently greater speed can be obtained. Our readers may be interested to know that the Union Carbide Company of Chicago have bought the plants at Niagara Falls, at Sault Ste. Marie, Michigan, and in Virginia, the united company being capitalized at $6,000,000 or $8,000,000. Large developments are in consideration in Canada, also, and at Grand Mere, in the Province of Quebec, a water-power capable of yielding 100,000 horse-power has been acquired to extend this interesting industry. The promoters have unlimited capital at their back, among those interested being William McKenzie, the well-known capitalist of Toronto.

ASSOCIATED PLUMBERS' CONVENTION.

The second meeting of the National Association of Master Plumbers of Canada was held at Quebec on June 29th and two following days, Joseph Wright, of Bennett & Wright, Ltd., being in the chair. By carefully reading the reports of the officers and committees and the minutes of the business done during the three days' deliberations of the association, the public will come to the conclusion that its interests appear to be taken into scant account. The published reports show that the chief aim of the meeting of the association and the previous executive meetings was to create a monopoly in the trade for the benefit of the members and to make rigid rules which would bring all the trade into line with the combination. There is a total absence in the association's discussions and the officers' reports of subjects touching on improved sanitary methods and scientific plumbing, heating or gas fitting.

If the proceedings of the Associated Master Plumbers of Canada, so far as made known, be a sample of the treatment the public may expect at their hands, then we must accept the association as a combination in restraint of trade, whose aim is to increase its members' profits at the expense of the public liberty and purse. It is quite legitimate and even commendable for trades and business men to associate together, and combine their influence, knowledge, and advice, to protect themselves and to exchange ideas with each other with a view to raising the standard of the trade and improving the class of work and remuneration, but when associations make it their business to interfere with the liberties of others and damage private enterprise by using their combined strength to compel others to adopt their views, rulings and methods of working, or retire from business, it is quite time that the public should make its voice heard in the discussion. The report leads us to believe that this association intends if possible to secure Acts of Parliament and by-laws in every town that will enforce the Master Plumbers' Association's dictatorship on the population of this country, which is already sufficiently ruled and regulated. The city of Toronto appears to be the birthplace of the association, and during the past few years we have been able to note how such a monopoly works, and therefore gather some idea of what may result when the association fully develops and its rules are enforced by the Legislature. When the Toronto association was only a few months old, and standing alone, it persuaded the Toronto city council to embody some of its ideas in by-laws, and no person was permitted to commence or carry on the business of master plumber or do a job of plumbing work on his own account, except he passed the Toronto Board of Plumbers' examinations and had an established place of business. The board consisted of Joseph Wright, W. J. Burroughs, master plumbers, and E. J. Lennox, city architect. This body has also the privilege of saying who was qualified to fill the appointment of inspector of plumbers' work and enforce the city by-laws. It will be obvious that such extensive powers in the hands of business men require the most judicious and conscientious exercise, and that even then friction would be occasioned. The journeymen were to be examined also, but a strike made it impossible to carry this out and the idea was dropped.

Some difficulty has been experienced in enforcing the Toronto by-law, and in some cases the city has failed to secure convictions under it, though there was no doubt that the defendants were not licensed and were carrying on business as plumbers. We find by the reports of the Quebec meeting that the difficulty in compelling all plumbers to enter the combination is about to be overcome in another way. The manufacturers of plumbers', gas and steam fitters' supplies must act in harmony with the Master Plumbers' Association of Canada and agree to sell goods at manufacturers' prices only to members of the association. This will practically prevent anyone doing business who can not or will not join the combine, because he will not be able to secure the necessary material at trade prices. We may also expect that in time the license fee will be advanced to an amount that will prevent anyone but a capitalist paying it, and thus prevent those who have served an apprenticeship, but are not fortunate enough to possess the money to pay the license fee, from taking the advantage of their years of education and work. We have also observed the great difference in the two tenders for the plumbing and heating of the new city hall, Toronto, the one being made at the time the other contracts were let, and the other accepted a few years after, when the Toronto Master Plumbers' Association had had time to get its members into line.

WHO IS "EXPERT"?

I notice in your last issue that John McDougall, the agent for the International Sewage Purification Co., demands my name. It is Henry Lee McKinstry, born at Armagh, Ireland, my father being a land owner there and medical health officer for the district. I, myself, was formerly a traveler in England representing a wine manufacturing syndicate, and I came to Canada a few years ago with the intention of learning the habits and customs of the people, and the value of the land, the products, minerals, etc. I hear and secure considerable information on many important subjects and know probably more about sewage purification and the international system than Mr. McDougall does himself, and I am prepared to prove every word spoken in the letter complained of, and to discuss sewage purification with Mr. McDougall in any public hall, after November 15th, when I propose to make a long stay in Toronto, and allow the audience to say by show of hands whether Mr. McDougall or myself is the most competent person to judge such an important subject. I have no interest in any sewage scheme in this or any other country, or desire to interfere with any private or public business, nor am I acquainted with Mr. McDougall or any other agent, but when I became acquainted with all the facts of Mr. McDougall's offer made to a special committee of Toronto City Council on March 17 last, I thought I was only doing right, with the experience and knowledge I possessed of the subject in England, to say a few words that would help the public to judge intelligently for themselves in Canada. Being a British subject and living until lately on the tight little islands of England and Ireland, I naturally supposed that the general public of a British colony possessed certain lawful rights of criticism, and that when a drummer made an offer to sell goods to the representatives who had to pay the bills, that the public or any single individual might point to errors, or discuss the value of goods or systems offered to the public without being threatened by the vendors or their agents. I suppose Mr. McDougall will bring Chas. G. Horetzsky, C. E., to task in the same way for the letters he has published in the London, Ont., Advertiser on the same subject. I think it is now time that Mr. McDougall and his principals proved at least one-tenth of the statements which they make in their printed pamphlets about the efficiency of their systems now working in Great Britain, and any Canadian municipality that wishes to protect the health and interests of its constituents should at least have wisdom enough to send an experienced and disinterested person to England to investigate a system upon which it proposes to spend thousands of dollars. It is now in Mr. McDougall's power to prove to the public and the press whether he or I am the biggest coward, and whether the system which he is pushing is an efficient purification system or a financial success.

H. L. McKinstry.

Toronto, July 20th.

NEWFOUNDLAND COAL.

Very favorable accounts have been received from the new coal mines near Grand Lake, Newfoundland, now being opened and worked under the Reid contract. Extensive borings have been made on three of the seams resulting most satisfactorily, the quality of the coal being excellent, and the thickness of the seams increasing. The Imperial Institute, in a circular recently issued, furnishes the results of an analysis of this coal. A small sample, about three ounces, had been sent to the institute from the 6 feet seam for analysis. The circular states that the coal was found to be bright, clean and tough, presenting an irregular conchoidal fracture, and the following results on analysis:—

Fixed carbon	47.19
Ash	10.82
Coke	58 01
Volatile matter	41 99
Sulphur	.735
Calorific value	6347.

The sample caked fairly well, furnishing a coherent, somewhat brittle, coke. The ash is nearly white. This will probably prove to be a good heating coal of fair quality, containing very little sulphur, though rather a low proportion of fixed carbon.

Number two sample from 2½ feet seam weighed about two ounces. The coal was dull, rather brittle, but clean and not dusty. The analytical results were as follows:—

Fixed carbon	49 32
Ash	13 05
Coke	62 37
Volatile matter	37.63
Sulphur	62
Calorific value	6435.

The coal burns slowly and cakes fairly well, furnishing a somewhat brittle coke. The ash is gray. This coal closely resembled the former sample. It must be remembered, too, that these are almost surface specimens and the coal is likely to improve as the mine deepens. Should the coal seams develop according to expectations it is needless to say that the benefit to the colony will be immense.

—In a lecture before the London Chamber of Commerce, Wm. Ogilvie spoke very plainly about the way in which his name and his reports had been used by promoters for their own ends. He said: "My name has been quoted pretty prominently in a great many prospectuses, and I have been made to say a good many things that I have never said at all. I simply say this as a warning: Do not pay the slightest attention to any extracts from my reports. They may be correct quotations, but they are often misleading. I have no interest in any company; my sole object is to benefit my own country, Canada, and the Empire of which it is a portion."

MINERAL PRODUCTION OF THE UNITED STATES IN 1897–8.

(PRELIMINARY STATEMENT.)

Compiled for THE MINERAL INDUSTRY, Vol. VI.

By Richard P. Rothwell, editor of the *Engineering and Mining Journal.*

Number.	Products	Customary Measures.	1896.				1897.			
			Quantity.		Value at Place of Production.		Quantity.		Value at Place of Production.	
			Customary Measures.	Metric Tons.	Totals.	Per M. Ton.	Customary Measures.	Metric Tons.	Totals.	Per M. Ton.
	NON-METALLIC.									
	Abrasives:									
1	Carborundum	Sh. T.	595	539	$365,612	*j*$0.68	621	563	$153,812	*j*$0.27
2	Corundum	Sh. T.	250	227	35,000	154.19	230	209	32,200	154.07
3	Crushed steel	Sh. T.	326	296	50,624	171.00	324	294	51,824	176.00
4	Diatom. earth	Sh. T.	3,540	3,211	34,200	10.65	3,000	2,721	30,400	11.17
5	Emery	Sh. T.	1,550	1,406	108,500	77.17	1,500	1,361	105,000	77.15
6	Garnet	Sh. T.	2,440	2,214	85,400	38.57	2,260	2,050	79,100	38.57
7	Grindstones	Sh. T.	31,301	28,396	294,338	10.36	36,651	33,250	366,675	11.00
8	Pumice	Sh. T.	*Nil.*				1,700	1,542	8,500	5.51
9	Quartz crystal	Sh. T.	6,000	5,432	16,500	3.04	6,000	5,432	16,500	3.04
10	Tripoli	Sh. T.	1,405	1,275	4,823	3.79	1,631	1,479	5,475	3.70
11	Whetstones				105,201				80,220	
12	Alum	Sh. T.	14,090	12,782	422,700	33.07	15,456	14,021	463,680	33.07
13	Aluminum sulphate	Sh. T.	42,240	38,319	1,056,000	27.56	46,355	42,053	1,158,875	27.56
14	Ammonium sulphate	Sh. T.	257	233	10,280		3,111	2,822	124,440	
15	Asbestos	Sh. T.	716	650	12,670	19.49	770	698	15,400	22.06
16	Asphalt	Sh. T.	20,414	18,519	362,590	19.58	27,397	24,854	486,620	19.58
17	Asphaltic limestone	Sh. T.	5,000	4,536	55,000	12.12	2,390	2,168	11,450	5.28
18	Bitumin's sandstone	Sh. T.	51,956	47,134	132,500	2.81	41,185	37,363	125,555	3.36
19	Barytes	Sh. T.	21,900	19,867	87,600	4.41	27,316	24,781	109,264	4.41
20	Bauxite	L. T.	17,096	17,369	42,740	2.46	20,590	20,919	41,180	1.97
21	Borax (crude)	Sh. T.	13,320	12,084	266,400	22.04	19,400	17,599	388,000	22.05
22	Bromine	Lb.	559,285	253	143,074	*j*0.57	487,149	221	136,402	*j*0.62
23	Calcium carbide	Sh. T.	860	780	48,000	61.54	1,925	1,746	134,750	77.17
24	Cement, nat. hydraul.	Bbls *a*	7,407,311	1,007,980	4,385,962	4.35	7,781,377	1,058,883	4,127,124	3.90
25	Cement, Portland	Bbls *b*	1,577,283	286,181	2,502,479	8.74	2,272,971	412,405	3,578,839	
26	Cement, slag	Bbls *e*	*Nil.*				40,000	6,350	60,000	9.45
27	Chrome ore	L. T.	702	713	7,775	10.90	50	51	550	10.78
28	Clay products	Sh. T.			65,000,000				*q*60,000,000	
29	Coal, anthracite	Sh. T.	48,133,930	42,667,101	86,682,749	2.03	52,645,133	47,759,665	85,857,717	1.79
30	Coal, bituminous	Sh. T.	139,468,659	126,525,967	113,401,602	0.89	147,557,599	133,864,599	120,505,982	0.89
31	Coal, cannel	Sh. T.	54,661	49,588	146,491	2.95	56,511	51,267	153,145	2.98
32	Coke	Sh. T.	10,369,015	9,406,770	17,311,823	1.84	12,742,340	11,563,673	23,367,879	2.02
33	Cobalt oxide	Lb.	12,825	*j*5,817	17,314	*j*2.98	19,300	*j*8,754	32,810	*j*3.75
34	Copperas	Sh. T.	11,170	10,133	52,662	5.19	11,924	10,818	56,565	5.23
35	Copper sulphate	Lb.	48,732,840	22,150	1,953,225	88.18	51,012,945	23,139	2,040,518	
36	Feldspar	L. T.	24,907	25,305	124,251	4.91	20,900	21,234	113,773	5.36
37	Fluorspar	Sh. T.	6,000	5,432	48,000	8.83	9,025	8,187	74,456	9.09
38	Fullers earth	Sh. T.	11,326	10,275	68,476	6.66	17,049	15,467	91,634	5.93
39	Grahamite (*k*)	Sh. T.	1,282	1,163	38,460	33.07	1,756	1,592	52,680	33.09
40	Graphite, crystalline	Lb.	405,006	*j*183,709	18,225	*j*.10	993,138	*j*450,487	44,691	*j*.10
41	Graphite, amorphous	Sh. T.	574	520	3,850	7.40	1,200	1,090	11,460	10.45
42	Gypsum	Sh. T.	195,553	177,405	583,136	3.29	223,061	202,360	711,952	3.52
43	Iron ore	L. T.	16,000,056	16,256,057	31,200,889	1.93	18,316,967	18,610,038	31,138,844	1.67
44	Litharge	Sh. T.	6,500	5,897	540,300	91.57	9,900	8,981	899,100	100.11
45	Magnesite	Sh. T.	2,067	1,875	9,715	5.12	1,907	1,730	7,628	4.41
46	Manganese ore	L. T.	162,526	165,126	339,083	2.05	156,787	159,296	332,700	2.09
47	Mica, ground	Sh. T.	570	517	9,687	18.73	2,692	2,442	38,218	15.65
48	Mica, sheet	Lb.	17,630	*j*7,997	12,528	*j*1.57	92,335	*j*41,883	45,615	*j*1.09
49	Mineral wool	Sh. T.	5,853	5,309	61,614	11.60	5,667	5,141	45,494	8.81
50	Monazite	Lb.	17,500	8	875	109.37	40,000	18	2,000	111.11
51	Natural gas				10,000,000				10,000,000	
52	Paints, metallic	Sh. T.	31,865	28,908	342,167	11.15	36,293	32,925	370,594	11.26
53	Paints, ocher, etc	Sh. T.	17,835	16,179	178,793	11.05	11,151	10,116	110,165	10.89
54	Paints, venetian red	Sh. T.	5,998	5,309	93,586	17.62	4,596	4,169	55,690	10.96
55	Paints, white, red ld.	Sh. T.	95,955	87,049	7,868,310	90.39	103,225	93,654	9,291,150	99.21
56	Paints, zinc oxide	Sh. T.	15,863	14,391	1,189,725	82.67	26,262	23,825	2,100,960	83.18
57	Petroleum (crude)	Bbls *d*	55,254,795	7,730,425	65,753,206	8.50	56,985,643	7,972,579	44,804,962	5.62
58	Phosphate rock	L. T.	937,372	952,370	2,812,116	2.95	906,080	920,577	2,718,240	2.95
59	Precious stones				200,000				101,000	
60	Pyrites	L. T.	109,282	111,030	292,626	2.63	128,468	130,523	379,699	2.83
61	Salt	Bbls *e*	15,707,908	1,995,017	5,328,250	2.67	13,153,524	1,670,592	4,859,364	2.91
62	Silica, sand & quartz	L. T.	720,399	731,925	1,076,038	1.47	750,000	762,000	1,125,000	1.48
63	Slate, roofing	Sq'es.	699,100		2,260,862	*n*3.23	895,372		2,695,580	*n*3.01
64	Slate, manufactures				467,578				547,645	
65	Soapstone	Sh. T.	14,350	13,018	143,500	11.02	18,974	17,213	189,740	10.91
66	Soda, natural	Sh. T.	3,000	2,722	65,000	23.88	5,000	4,536	110,000	24.25
67	Soda, manufactured	M. T.		157,475	3,621,925	23.00		277,072	5,774,656	20.84
68	Stone, for building				30,599,804				30,000,000	
69	Stone, limestone (flux)	L. T.	3,794,173	3,854,882	1,669,437	0.43	4,247,688	4,315,651	1,868,983	0.43
70	Strontium sulphate	Sh. T.	*Nil.*				40	36	200	5.55
71	Sulphur	L. T.	3,800	3,861	72,200	18.70	1,690	1,717	34,814	20.27
72	Sulphuric acid	Sh. T.	1,019,501	924,885	17,331,517	18.74	1,128,741	1,023,987	21,446,079	19.19
73	Talc, common	Sh. T.	7,098	6,439	63,585	9.87	9,563	8,675	82,795	9.54
74	Talc, fibrous	Sh. T.	51,816	47,007	256,080	5.45	58,836	53,376	288,185	5.39
75	Uranium ore	Sh. T.	*Nil.*				17	15	9,010	600.66
76	Zinc ore, exported	L. T.	2,324	2,361	47,408	20.08	9,251	9,399	211,350	22.48
77	Est. prod. unspecified				5,000,000				5,000,000	
	Total non-metals				484,999,136				481,692,497	
	METALS.									
78	Aluminum	Lb.	1,300,000	*j*589,676	$520,000	*j*$0.85	4,000,000	*j*1,814,400	$1,400,000	*j*$0.77
79	Antimony	Lb.	1,226,000	556	84,717	152.37	1,500,000	680	107,250	157.72
80	Copper (*m*)	Lb.	479,806,183	217,639	51,003,397	234.35	510,190,719	231,421	56,325,055	243.39
81	Gold	Oz. *f*	2,558,433	*j*79,576	52,886,209	*j*664.60	2,864,576	*j*89,092	59,210,795	664.60
82	Iron, pig	L. T.	8,623,127	8,761,097	91,577,610	10.45	9,652,680	9,807,123	92,677,312	9.45
83	Iridium	Oz.					20.25		606	
84	Lead, value at N. Y.	Sh. T.	174,792	158,479	10,411,643	54.07	197,718	179,368	11,784,093	65.73
85	Nickel	Lb.	17,170	*j*7,788	4,464	*j*0.57	33,700	*j*15,286	11,668	*j*0.76
86	Platinum	Oz. *f*	200	*j*6.21	2,800	450.89	200	*j*6.21	3,000	482.39
87	Quicksilver	Flks *g*	29,863	1,036	1,104,997	1066.58	26,079	965	991,002	1026.94
88	Silver, comm'l value	Oz. *f*	58,488,810	*j*1,819.208	39,245,992	*j*21.58	56,457,292	*j*1,756.004	33,755,815	19.22
89	Zinc	Sh. T.	77,637	70,432	6,117,796	86.86	100,387	91,070	8,271,889	90.83
	Total metals				252,959,625				264,538,485	
	Grand totals				727,958,761				746,230,982	

(*a*) Barrels of 300 lb.; (*b*) 400 lb.; (*c*) 200 lb.; (*d*) 42 gal.; (*e*) 280 lb. (*f*) Troy ounces. (*g*) Flasks of 76½ lb. (*h*) Bituminous coal includes brown coal and lignite. The anthracite production is the total for Pennsylvania, Arkansas, and Colorado. (*i*) Estimated. (*j*) Kilograms or per kilogram. (*k*) Including bitumen from Texas. (*m*) The value of the copper production is calculated at 0.25c. per lb. less than the average price of Lake copper at New York. (*n*) Value per square. (*p*) Value per cubic foot. (*q*) This figure is only approximate and will be revised.

Abbreviations: Sh. T., short tons (2,000 lb.); L. T., long tons (2,240 lb.); M. T., metric tons (2204.6 lb.); Sq'es, squares (100 sq. ft., lapped and laid).

UNITED STATES MINERAL PRODUCTION IN 1897.

We give in the accompanying table the completed statistics of the production of minerals and metals in the United States, as collected and arranged for Volume VI. of "The Mineral Industry," which is now in press. The total value of the mineral production of the United States in 1897 was, therefore, $746,230,982, against $737,958,761 in 1896. The values given are generally at the mine or works; but with a few of the principal metals—such as lead, copper or zinc—this is not possible, and their values are taken at the leading markets. The total value of the output in 1896 exceeded that of the mineral and metal production of all continental Europe, and nearly doubled that of the United Kingdom, the value of whose mineral output in 1896 was, in round figures, about $340,000,000, while that of Germany was about $300,000,000, that of France about $110,000,000, and that of Belgium $100,000,000.

Deducting necessary duplications, we find that the total value of the production of the United States in 1897 reached the sum of $678 966,644.

This output is limited entirely to ores and other substances mined in the United States and to metals reduced from those ores. In addition there was also a large quantity of metals reduced or refined in the United States from imported ores or base bullion. These are chiefly sent here for treatment from Canada and Mexico. The total production of this class reported was 584,983 ozs. gold; 40,218,776 ozs. silver; 26,938,254 lbs. copper; 4,099,390 lbs. nickel; 92,117 short tons lead; the total value of these metals being $47,127,174. This output of metallurgical works is altogether additional to that recorded in the table. These metals were obtained chiefly from ore, bullion, furnace products and silver-lead imported from Mexico, Newfoundland and Canada. A comparatively small amount of gold and silver ore and bullion comes from Central and South America. Also there was received a large amount of pyrites from Spain and Portugal, all of which contains a little copper. From British Columbia and Mexico came chiefly lead-bearing ore and silver-lead, from which a large part of our lead supply is obtained. The nickel is all from ores or matte produced by the mines at Sudbury, Ont. We have not included in the above quantities the iron smelted from foreign ores, which is small in actual amount and insignificant in comparison with the total output; nor have we included the manganese in foreign ores which enters into the composition of the spiegeleisen and ferro-manganese that is made in the United States. The lead industry is the one most affected by the foreign material that is imported, the quantity of copper being comparatively small.

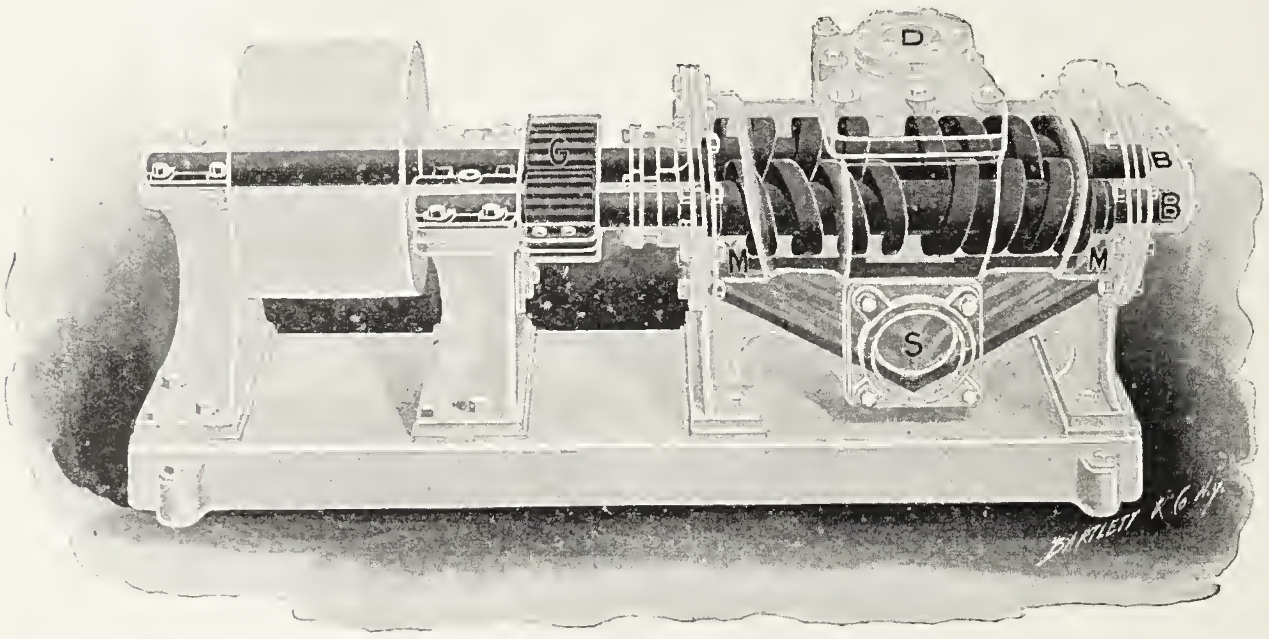
We have given the production of the different articles in metric tons (or kilograms in the case of precious metals), as well as the customary measures, for the reason that the metric measures are those recognized and used by almost all of the civilized world, and are rapidly gaining recognition in the few remaining countries which have not yet fully adopted them. In the United States they are already legalized, with the prospect of their compulsory and exclusive use at an early date. How desirable such a change will be can be best appreciated by those who have had occasion to collect or use statistics of this kind.

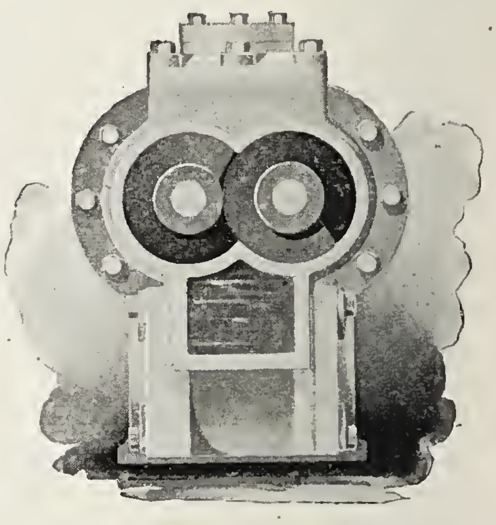
THE QUIMBY SCREW PUMP.

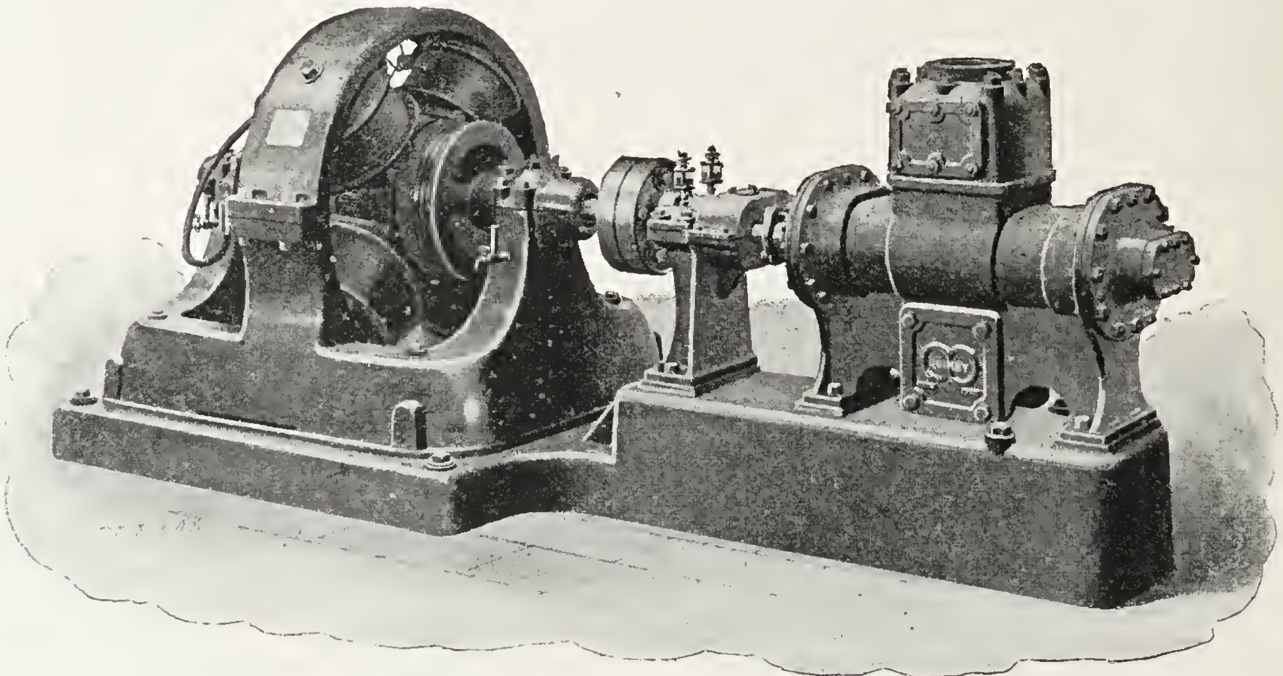
By W. T. Bonner, Montreal.

The novel feature of the pump is its simplicity, utilizing as it does a very simple mechanical principle in a very unusual manner for performing useful work.

As will be noticed by an inspection of the accompanying illustrations, the Quimby pump consists of two parallel shafts, on which are mounted the four screws that act as pistons in propelling the water, so arranged that in each pair the thread of one screw projects to the bottom of the space between the threads of the opposite screws. The screw threads have flat faces and peculiarly undercut sides; the width of the face and the base of the thread being one-half the pitch. The pump cylinder fits the perimeters of the threads, as shown in figure 2. Space enough is left between the screws and the cylinder and between the faces of the intermeshing threads to allow a close running fit without actual contact. There is no end thrust of the screws in their bearings, because the back pressure of the column of liquid is delivered to the middle of the cylinder, and the endwise pressure upon the screws in one direction is exactly counterbalanced by a like pressure in the opposite direction. The suction connection is shown at S in Fig. 1, and opens into a chamber underneath the pump cylinder. The power to drive the pump is applied to one of the shafts, and the second shaft is driven by means of a pair of gears, shown at G in Fig. 1. The pump has no internal packing, no valves, and no small moving parts.







The Quimby electric pump is especially valuable in connection with the hydro-electric operation of elevators. When used in connection with the pressure tank system, the suction is connected with the elevator discharge tank, the pump discharging into the pressure tank. The pump is controlled by means of a pressure regulator and starting box. When the pressure in the tank falls, the regulator operates the starting box and the pump runs until the pressure has been restored in the tank to the required number of pounds. By the peculiar construction of the Quimby pumps there is no pulsation. When used in connection with the gravity system, the pump section is connected with the lower discharge tank, and the discharge from the pump is elevated into the roof tank. The pump is controlled by means of a float in the discharge tank, and a starting box.

The Quimby electric pump, when applied to an elevator, can be automatically operated, thus doing away with the constant care and attention required by a steam pump. Whether operated by belt or direct connected to electric motors or steam engines, the Quimby pump has many advantages. For waterworks, oil refineries, or other service where liquids are pumped through long pipe lines, any pulsation in the delivery adds to the difficulty of maintaining tight joints. The Quimby pump, however, has an absolutely pulseless delivery, and at the same time a very high efficiency. Long series of tests show an average efficiency of more than 55 per cent. from wire to water. In many instances tests have shown as high as 65 or 66 per cent. efficiency.

The pump will readily handle thick products, such as paraffine, hot tar, pitch, white lead, melted sugar, glucose, soap, lard, etc. For this service, reciprocating pumps are not desirable, for the reason that heavy liquids are likely to be churned by the action of the plungers, and the friction of the material passing through the valves and ports, greatly reduces the capacity and efficiency. Altogether the Quimby pump appears to offer a wider range for the utilization of electric power than any other apparatus presented for some time past and in a field also where cost of installation and operation are both very important factors.

W. Edmonds, contractor, has begun the brick work of the addition to McDougall's foundry, Galt, Ont.

The output from the Chicoutimi, Que., pulp mills is to be exported from Quebec, a steamer being loaded every second week.

The Brockville, Ont., city council has purchased a site for the factory of the Brockville Provision and Packing Company. Plans and specifications are being prepared by Montreal and Chicago experts, and an extensive plant including first-class cold storage facilities will be installed.

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*Extract from a paper read before the Canadian Electrical Association.

THE STEAM END.*

BY JAMES MILNE.

In a paper read at a former convention of this association, it was stated that purchasers of electrical apparatus made very careful enquiries as to the efficiency of same, the price being of secondary importance. If this applies to the electrical, why should it not apply to the steam end as well ? I am sure that there are very few plants where the proprietors, or those in charge, enquire as to the efficiency of the boilers and engines, the price with these items being the very first consideration, generally. It is very seldom, in specifications for steam plants, that there is anything said about the efficiency of the boilers, or the water consumption per horse-power at the engine. This I consider one of the most important points in connection with the steam plant. There are engines running which are supposed to be first-class and up to date, where the water consumption per horse-power is nearly double what it ought to be, and if the management in some of these plants would go to the trouble of calculating the coal consumption per electrical horse-power at the bus, I am of the opinion that the results obtained would simply astonish them. I, myself, have records of the coal consumption of a plant, together with the total meter readings, extending over a number of years, and allowing for the loss on the line, together with that on the generators, and although the plant was a non-condensing one, yet the records there are not out of the way. In another plant where I was making a two days' test as to the relative values of coal, I found the coal consumption per E. H. P. at the bus just double the former plant, which might be considered high by some. This second plant was condensing. The load was of such a nature as to make the engine very unsuitable for the work.

I am inclined to think that builders of engines should be made to guarantee a certain steam consumption per indicated h.p. at say 25 per cent. over-load, full load and half load, and that tests should be made to determine if the guarantee has been fulfilled. If the guarantee has been more than fulfilled, let a bonus be given to the builders, and if not fulfilled, so much to be deducted for every 1 per cent. below the guarantee; and if it falls below a certain amount, that is to say, the steam consumption exceeds a certain fixed value, the engine to be removed, or the builders to accept a nominal figure for same. I think if means of this kind were adopted we would get engines of a very high order. Engineers, as a rule, are content so long as they get a fine looking card from their engine, but they very seldom from these cards calculate the steam consumption, which is of vital interest. We have quite a large number of good engine builders in the country, but the number guaranteeing their efficiency is very limited indeed; in fact, I am not aware of any. If tenders are invited for a certain style of engine and the tenderers are called upon to guarantee the steam consumption per B. H. P., the party to receive the contract is the one guaranteeing the least steam consumption per h.p. hour, the cost being of secondary importance. After the engine has been installed and run for some time so as to get down to its proper bearing, carefully conducted tests should be made to ascertain if the guarantee has been fulfilled.

The matter of efficiency of boilers is also one of great importance, but it is not so easily arrived at, owing to the difference in coal. At the same time, however, it would not be a very difficult matter to fix on a certain coal for a standard, and to guarantee so many pounds of water evaporated per lb. of that coal. All boilers, I believe, should be sold by the Centennial Standard, and should be capable of developing their rating with easy firing, showing good work with ordinary coal, and should be capable of being forced 50 per cent. above their rating. There was a recommendation something to this effect made by the Committee of Judges at the Centennial Exhibition, the horse power being 34½ lbs. from and at 212 degrees, which is equivalent to 33,305 heat units. We should get an efficiency close on to 80 degrees with good boilers, and this could be roughly determined with anthracite coal, and if we get 12 lbs. of water evaporating from and at 212 degrees, we have approximately this efficiency, the heating value of the combustible being about 14,500 heat units, which is equivalent to 15 lbs. evaporated from and at 212 degrees, therefore 80 per cent of this gives us 12 lbs. With bituminous coals we have not such uniformity, and it is necessary to determine its heating value either by the coal calorimeter or chemical analysis.

After our boilers and engines are installed, we have to face the problem of running them. It has often been stated that men could be got to do anything, men being more easily replaced than machinery, costing practically nothing as it were. I am of the opinion that this is wrong. Cheap men are numerous we know, but are in the long run very expensive. Good men are scarce, and nowhere is this more noticeable than in the boiler room. Good firemen are very scarce, coal shovellers numerous. In my humble estimation, credit is not given to the firemen that should be. If a plant is run fairly economically as far as coal consumption is concerned, the engineer is more apt to get this credit, but as a matter of fact all he does is to turn on the steam and see that the bearings are oiled. Now and again he may walk into the boiler room to ascertain if the fireman is asleep or not. To have good firing the greatest of skill has to be manifested to get the best results from the coal, and where we are dependent on skill to get first-class results we are depending on a very uncertain quantity. Too much latitude is given the fireman in the matter of coal, and he has it in his power to make or lose nearly a dividend for the company that employs him. Attention is being given to this subject by the largest steam users in the country, whereby the duties of the fireman are being greatly relieved by mechanical devices; their action being positive and not dependent on skill, the machines thus taking the place of the brains of the fireman. This you will agree is a great step in advance, and makes central station management very independent regarding firemen.

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*A paper read before the Canadian Electrical Association.

IMPULSE WATER WHEELS.*

By J. T. Farmer, Ma E.

(Concluded).

II.—Nozzle .7532 in. diameter. (a) Pressure 75 lbs. per sq. inch. Equivalent head = 175 feet. Discharge = 120 gallons per minute.

Speed.	Horse Power.	Efficiency.
402	3.68	58.5
501	4.10	65.0
618	4.34	68.8
675	4.34	68.9
750	4.33	68.7
770	4.30	67.7

(b) Pressure 100 lbs. per sq. inch. Equivalent head = 235 feet. Discharge = 138 gallons per minute.

Speed.	Horse Power.	Efficiency.
370	4.82	49.4
371	4.86	50.0
475	5.67	58.4
515	5.95	60.7
588	6.20	63.9
654	6.60	67.8
698	6.66	68.6
756	6.88	70.8
815	6.72	69.3
911	6.35	65.6

In connection with the above results it is interesting and important to notice that the highest actual efficiency appears at a speed which is about .9 of that which theoretically should give the maximum efficiency.

A most important difference between an impulse water wheel and a turbine of either the impulse or pressure type is that the construction of the latter allows a larger area of water to be applied to the wheel for the same dimensions of wheel. In the turbine the wetted surfaces bear a much larger proportion to the size of the wheel than in an impulse wheel, and those surfaces in the turbine are constantly in action, while in the impulse wheel their action is intermittent. When the head of water is small a correspondingly large quantity has to be used to give a required horse-power, and in this case the turbine has the advantage of passing a much larger quantity than the impulse wheel. When the head is very large this feature of the turbine becomes a disadvantage, as it becomes a difficult problem to curtail the total discharge of water so that the total power developed may be handled without mechanical inconvenience by the working parts of the motor.

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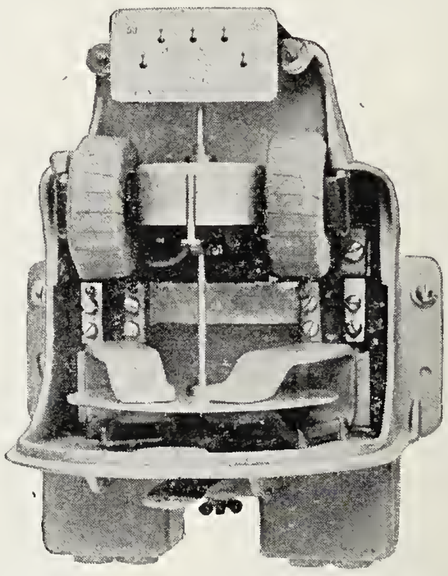
*From a Paper read before the Canadian Society of Civil Engineers.

In order to develop considerable power, with a comparatively small head using an impulse wheel, one of two things must be done: either the area of the nozzle and consequently that of the vanes must be made very large, which is only practicable to a limited extent, or else the number of nozzles and wheels must be multiplied. Thus the use of impulse wheels under small heads involves a large amount of machinery for the power obtained. On the other hand, the impulse wheel has many points in its favor, chief among which is its simplicity of construction, which leads directly to the absence of mishaps and to ease of maintenance. The bearings are simple, being merely those on the horizontal shaft, in such a position as to be easily got at when necessary to make any repairs or adjustments. There are no bearings running under water; and the bearings are not subject to any other reaction than that due to the useful effect of the water on the wheel; no difficulty is met with corresponding to that of balancing the static pressure of the water on a turbine, which becomes such an important problem when large heads are being used. The impulse wheel has no water-tight joints, as there is no water pressure to be maintained among the working parts. The mechanism also does not contain any parts which are likely to work loose or otherwise become deranged and so lead to trouble.

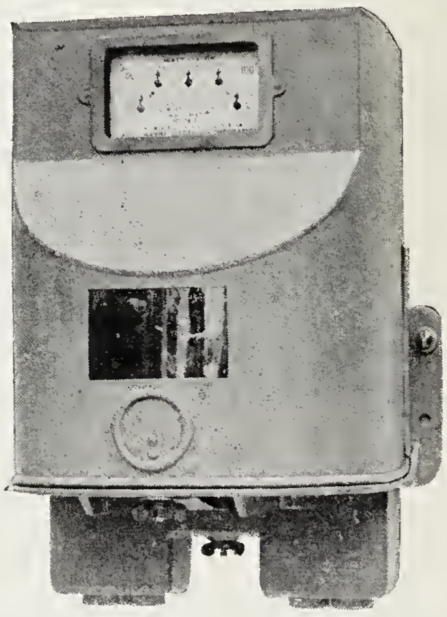
An important point in determining the practical usefulness of water motors is their adaptability to be run with a fair degree of efficiency under a fraction of the full load. This state of things is generally liable to occur either intermittently, as where a number of loads are being continually put on and off the mechanism driven by the motor; or periodically, as where for portions of a day or week or year the work required from the motor is heavier than at other times. Three methods will be mentioned which are employed to vary the output of work from the wheel. It was mentioned that three nozzle tips of different sizes were supplied with the wheel with which the tests were made. By changing these the quantity of water discharged under a given pressure can be varied as the area of the orifice. The power of the jet will consequently vary in the same ratio; and so any change of load which can be anticipated and will last for a considerable period can be provided for. The changing of the nozzle tips need not be a very difficult operation. It is, however, a very inconvenient plan to have to resort to to regulate the output of power from the wheel. These wheels are sometimes built with several nozzles placed at intervals round the periphery of the wheel. When this is the case the power can be reduced by shutting off the stream from one or more of the nozzles. The third method is to employ a valve or gate in the supply pipe which can be shut off to any desired extent by hand or by some automatic regulating machinery. This method is almost always necessarily employed in addition to those aforementioned. It will be noticed that the effect of the valve to reduce the power is reached by throttling the water as it passes the gate, thus reducing the pressure of the water as it reaches the orifice and consequently reducing also the discharge. It need hardly be pointed out that there is a great loss of efficiency when the motor is running under a light load, as the pressure energy which is not required to drive the machine is all absorbed without useful effect in the resistance of the partially closed valve. An idea of the actual efficiency reached can be gained from a consideration of the foregoing results, obtained for the small nozzle, for the range of heads from 120 to 300 feet. In calculating the efficiencies previously given, the available work was calculated on the assumption that the pressure under which the test was made was the total pressure available. But if that pressure is not the total available pressure as when the pressure is reduced by throttling from 125 to 100 or 75 lbs. per sq. in., then the total available work must be considered to be the product of the weight of water used and the head equivalent to the total available pressure before any throttling took place. In the preceding remarks an attempt has been made to describe and discuss the action of impulse water wheels, and more particularly of the wheel on which the experiments described were carried out; the question of efficiency has been illustrated and examined, and the advantages and disadvantages connected with the use of such a system have been pointed out. It is hoped that these notes may throw some light on this interesting and important subject.

DUNCAN INTEGRATING WATT METER.

This instrument embodies all the essential points that go to make it perfect in every respect. Its operation, like the lamp and ampere hour meters made by the Fort Wayne Electric Corporation and which are giving such good satisfaction, depends upon the induction principle, so that it is very simply constructed and entirely free from any commutator, brushes or other rubbing contacts. It is also the lightest and most compact induction watt meter on the market, so that it is very easily handled and installed. It also has an accuracy on all loads that is excelled by none. When once standardized it will remain accurate for years, this being due to the permanent magnets forming part of the retarding device being artificially aged by a new process. Another feature that readily recommends it, is a variable friction compensator with which it is equipped. This is something entirely new and provides for cases where the meter should run slow on one lamp after being installed some time, due to the jewel becoming rough. This is a complaint so familiar to the users of electric meters that it does not require to be dwelt upon here. Suffice it to say, however, it does the work and does it well, and without interfering or modifying the speed on any of the other loads. This meter is also applicable to systems having a varying rate of alternations due to uneven speed of the motive power, registering with extreme accuracy.



The principal elements employed in its construction are: Series coils that are mounted upon a laminated iron core which forms the greater portion of the magnetic circuit; an aluminum closed conductor or armature in the form of an inverted cup; and a shunt or volt coil mounted inside the said aluminum armature. The series coils are traversed by the main currents supplying the lamps or other translating devices, and magnetize the iron core in proportion to the amount of current through them. The volt coil is traversed by a current proportional to the electromotive force of the circuit, and is caused to lag behind the pressure by the addition of an impedence coil connected in series with it. This lagging or difference of phase between the magnetisms of the series and shunt coils causes them to combine into a common resultant which rotates the aluminum armature with a torque proportional to the watts. To make the speed correct and reliable, an aluminum disc is mounted upon the spindle with the armature and rotated be-



tween the poles of permanent magnets, the resulting action of which gives a speed exactly proportional to the watts or energy passing through the meter. The meter is made by the Fort Wayne Electric Corporation. One of these instruments is being presented to the electrical department of McGill University by the Fort Wayne Electric Corporation. It is a 10-light, 66-cycles, 125 volts kilowatt hour meter.

THE IMPORTANCE OF PROPER METHODS OF ILLUMINATION.*

BY F. A. BOWMAN, A. I. E. E., NEW GLASGOW, N. S.

In the last few years, since the electricity supply business has got beyond the stage of " systems " and controlling patents, there has been accumulated a great deal of most valuable information in regard to improvements in the generating and distributing plant, and to the best methods of realizing in practice the benefits from these improvements. From time to time there have arisen most animated discussions on the best system of rates, and methods of charging for the use of the current. The keynote of these discussions is the fact, brought to light by the accumulated experience of those companies that have been supplying electricity for some years, that the fixed charges grow steadily with the maximum demand on the plant, and that therefore the customers should be educated to use the current as many hours per day as possible. This is a matter of the most vital importance, and every central station man in this association should procure a copy of Mr. Arthur Wright's paper on " The Profitable Extension of Electricity Supply Stations," read before the National Electric Light Association at Niagara last year, and also one on the " Cost of Electricity Supply," read by him before the Municipal Electrical Association in England, and to study them until he knows them by heart.

It should be distinctly borne in mind, especially by the smaller companies, that to do a growing and really successful business, something more is necessary than to merely induce your customer to put in so many lamps and then to get as much pay as you can from him for them. It is now clearly demonstrated beyond a peradventure that the margin of profit is as narrow in the central station business as in any other, if not a great deal narrower, and that even when there is no competition from gas or a rival company the closest economy and best management are necessary to yield a profit to the shareholders and provide for future contingencies. In view of this the manager should realize that he must educate his clientele and give them the best satisfaction in every way. Too many managers are satisfied when they have succeeded in persuading a customer to take a certain number of lights. If in addition they are giving full pressure at the lamps and a reliable service they consider that their duty to both the company and the public is done. Now, this is a wrong principle. Attention should be paid to the purpose for which the light is required. Take for example a shop. The purpose for which it is to be used, its size, the height of ceiling, finish of the walls, kinds of goods to be displayed and sold, arrangement of counters and show-cases—all must be noted and considered. It is useless to attempt to light a modern drug store and a ready-made clothing store in the same way, and expect equally satisfactory results in both cases. The manager should be looked upon as authority on methods of lighting, and if he gives the matter a reasonable amount of attention he very soon will be. He must remember that he is a dealer in light and to be a successful one must know all about it—how it is best used and what are the latest fashions in it. If you go to a tailor for a suit of clothes you expect him not only to sell you the cloth and to make up the suit so that it will fit you fairly well, but you expect him to be able to tell you what are the latest styles and fashions and which of them are best adapted to the purpose for which you want them. Some managers will say, " Oh, I have a class of customers who do not care about fitting up nicely and will not spend money on it. All they want is that I will run the wires in and hang the lamps on cords as cheaply as possible." This man is mistaken. There is no community that will take electric light at all where a decided amount of education cannot be carried out. Education of his customers is a very material part of the work of every successful manager in the electrical business, and is one of the principal reasons why the business cannot be properly carrried on by some one who has a number of other interests to look after as well. The manager must study this question of proper illumination so as to master the main principles necessary to a clear understanding of it. He must study his customers so as to know what their tastes and requirements are. He must carefully watch the advertisements in the technical journals and the catalogues that are so plentifully distributed, and many of which contain accurate and valuable information, and then correspond with the advertisers to see if the articles that strike him as suited to some of his customers can be brought within their reach. Then he must canvass carefully and patiently, and if he fails one year must try again the next, because by that time he will know better how to work, his customers' ideas will have advanced somewhat, possibly prices will have dropped a little. The net result of all this is that he at last secures a contract for fitting up that is a pleasure to him to undertake and gives eminent satisfaction to the customer when done.

When first installing lights in the smaller towns and villages, cheap, but not poor work must be done to get the light introduced, but it should be looked upon as introductory only, and later on an earnest and continued effort be made to weed it all out.

A very common case that arises is that of a customer occupying a shop who is always making trouble about the bills. He has a certain number of lights strewed about without any definite arrangement, one switch to shut off the whole thing when he leaves, no shades, no reflectors, and the shop is half dark when all the lights are on, and if he is on meter and turns off a few to save money he has not light enough to do his work. The result is he is constantly growling himself and making others do the same.

When a case of this kind comes up the manager should go to him and suggest that by rearranging things he can have better satisfaction for less money, talk the matter over and work out a scheme that will put the light just where it is wanted, and add a few switches so that the groups of lights can be readily turned on and off. After the exercise of considerable tact and unlimited patience the customer will begin to be convinced and finally consent to refit. When this is done and the lights placed just where wanted, very possibly lamps of smaller candle power than before can be used on some of them. The result is a well lighted shop, which is a good advertisement for both the customer and company at a somewhat reduced cost to the customer and satisfaction all round.

The fewer lights the customer can install and yet get satisfaction from, the longer hours he will burn them all, and so tend to smooth off the peak of his individual load line. And the cheaper he can do it while still yielding a profit, the better for the company, as he is an advertisement and attracts others. Five customers, each of whom has ten lights and uses them all three or four hours each night, are better than one with fifty lights who uses them all for one hour and then turns off as many as possible.

It must be clearly borne in mind that the candle power of a lamp and the amount of illumination we get from it are two entirely distinct things. The useful illumination is the amount of light reflected back to the eye by the objects on which the light falls, and the quantity and quality of the light so reflected is the important and controlling factor, not the candle power of the source of light. The unit of illumination is the " candle-foot; " that is, a light of one candle power one foot distant from the object to be illumined. This is a comfortable light for reading. The illumination is given by the formula:

$$\frac{\text{Candle power}}{\text{Distance in feet}^2}$$

Thus a 16 candle power lamp 4 feet away gives 1 candle foot of illumination.

The illumination yielded by a certain lamp can be very materially increased by the use of reflectors. The illumination of an object which when below a small light is 1 can be increased to 23 by a paper reflector, to 30 by a white glass one, to 64 by a polished one, and to 260 by a silvered glass hemispherical one. White reflectors throw a very nice soft light and smooth off the edges of the shadows so as to produce a very pleasing effect. In using them it should be remembered that the ordinary law of reflection of light, viz., that the angle of reflection is equal to the angle of incidence does not apply to them; but that the rays of light at whatever angle they may strike the reflector spring off from it in lines perpendicular to its surface. Consequently there should be no attempt at the mathematical shapes of optical reflectors, but large flat surfaces must be used. They should always be painted a dead white. The enamelling of reflectors to have a shiny surface is a mistake; they do not give as good an effect to begin with and even the best rapidly lose their gloss.

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*A paper read before the Canadian Electrical Association.

The following table, due to Dr. Sumpner, gives the reflecting power of various surfaces and shows what a wide variation in the number of lights required for a given illumination may be caused by a change of interior decoration:

White blotting paper	82	per cent.
Ordinary foolscap	70	“
Newspapers	50-70	“
Yellow wall paper	40	“
Blue paper	25	“
Dark brown paper	13	“
Dark chocolate paper	4	“
Plain deal (clean)	40-50	“
Plain deal (dirty)	20	“
Yellow painted wall (clean)	40	“
Yellow painted wall (dirty)	20	“
Black cloth	1.2	“
Black velvet	.4	“

When studying out the lighting of a given place we must consider whether we merely wish for a general sense of the space being nicely or brilliantly lighted, as in a ball room or dining room; or whether particular spots or objects need to be clearly illuminated, as the goods in a shop or the tables in a library.

The most important step to good illumination is to secure to the utmost extent possible that no bright spots or lines of light shall strike the eye. The moment the eye sees the source of light it closes itself up for protection from the direct rays and consequently cannot receive as much of the light reflected from neighboring objects, and therefore does not see them distinctly. The following experiment will illustrate this very clearly: Take a shop with two show windows and hang the lights in one window about the level of the eyes, as is so commonly done, and in the other put the same number of lights in good reflectors close up to the ceiling. Now go across the street and note the result. In the first window the goods on exhibition are fairly well lighted, but it is a discomfort to look at them long and nothing is seen behind them. In the other window the goods are shown up beautifully and you can look at them as long as you wish and at the same time can see right back into the shop and see the goods on the shelves and counters.

In the smaller towns and in many cases in the larger ones the question of getting exactly the best illumination and effect from the lights must be subordinated to that of the cost both of the fitting up and of the current consumed. Also a certain amount of deference must be paid to the ideas of the owners.

Thus in lighting show windows the very best method is to light them from overhead, or from the corners, with lamps in deep and powerful reflectors that will throw the light directly on the goods to be shown and will shield it from everywhere else. If it is necessary for the proprietor to be as economical of light as possible this can hardly be done, as these lamps are useless for general illumination in the shop. In such a case as this clusters under good flat reflectors on the ceiling of the window are best. These show the goods in the windows very nicely, they make the front look much brighter, and at the same time throw a very considerable quantity of light into the front part of the shop where it is most required.

An exceedingly common case is a shop from 20 to 25 feet wide, 40 to 50 feet deep with two show windows, the ceiling being from 10 to 12 feet high, and used for dry goods, tailoring, groceries, etc. A very good arrangement for this is to put a three-light cluster and flat reflector in each window, and three similar three-light clusters down the centre of the shop. The main switch should be placed at a convenient spot near the door by which the employees enter and will of course turn on all the lights. Another switch should then be arranged to turn off the window lights, and another to turn off two lights in each of the clusters in the centre. This will be found to be a most convenient and economical arrangement for the customer, who can proportion his light to the weather and amount of business doing. While the central station man will find that, if the shop is open in the evenings at all, the whole of the lights will be on long enough to cover the maximum demand, or standing charges.

These clusters should not be more than 10' 6" from the floor; were these lights raised to 15 feet the direct light from them would be reduced one-half, calling for double the number to produce the same illumination, but since in this case the reflection from the ceiling and walls would be somewhat increased, probably an increase of 50 per cent. in the number of lights would be sufficient.

Drug stores generally call for special treatment, and the lighting must be made to harmonize with and to show off the fittings. Brackets on the top of the shelving and a handsome electrolier in the centre are generally very acceptable, but as the result desired is more in the way of brilliant effect than of mere illumination for the showing of goods, each case must be studied out to suit the purse and the tastes of the persons concerned.

In the matter of churches the great desideratum is the even distribution of the light, with absence of shadows and the total avoidance of all spots or lines of light that will strike the eye of the congregation, or of the minister, especially during the sermon. The minister, the choir and the organist of course require plenty of light, and it often calls for considerable ingenuity to supply their needs without having a bank of lights most unpleasant to the congregation. If such a group of lights cannot be avoided it should be provided with a switch within convenient reach so that it can be turned out during the sermon. In Anglican and Roman Catholic churches which have chancels separated by an arch from the main body of the building, the lights can often be arranged on this arch so as to be entirely hidden from the congregation and yet throw a very pleasant light on the choir and reading desks.

Lodge rooms should be well lighted, and as they are often finished in very dark colors this is a difficult matter. The lights should be divided into groups controlled by switches, and those at the desks of secretary and treasurer are often wanted to be independent of the others in the room. A dimmer is a valuable addition and should be arranged to control all the lights except those just mentioned. It should be a regular theatre dimmer of ample capacity. Lodges are not as a rule paying customers because their use of the light is irregular and the income per light from them very small. Nevertheless it pays to give a good deal of attention to the fitting up of them, because many get educated to good lighting through them whom it would be difficult or impossible to reach in any other way. It will require a good deal of work to get the first one well done and especially to get the dimmer introduced, but after that it will be comparatively easy.

SOME NOVELTIES IN SWING BRIDGE CONSTRUCTION ON THE TRENT VALLEY CANAL.*

By R. B. Woodworth.†

The Trent Valley Canal, now in process of construction by the Dominion of Canada, is projected to extend from Georgian Bay through the province of Ontario to Lake Ontario, and is expected to be of great public value as a waterway. Its construction has naturally demanded numerous high-level and swing bridges.. Several of these were erected during the past year by the Central Bridge & Engineering Co., of Peterborough, Ont., and the purpose of the present paper is to describe certain peculiarities in the construction of the two more important of these, in the design and detail of which the present writer was directly interested.

These were the swing bridges to carry the Grand Trunk Railway over the canal at Nassau, Ont., and the Canadian Pacific Railway over the canal at Ashburnham, Ont. The former had a clear span of 217½ feet c. to c. of end lifts, and the latter a span of 187 feet c. to c. of end lifts. Both were of the same general design, riveted lattice trusses with minor differences due to the different lengths of span and the idiosyncracies of the men who framed the new Canadian tariff. When the material for the long span was ordered angles were most economical; when we came to detail the short span the tariff had made it preferable to use channels. Both were figured for the loadings given under Class II. of the 1896 specifications of the Department of Railways and Canals, viz.: the dead load of the spans themselves, cross ties, rails, etc., at 500 lbs. per lineal foot of span, and a rolling load of two 112-ton locomotives with a uniform train load of 3,000 lbs. per lineal foot. For the longer span this gives a loading on the turntable, when the bridge is swinging, of about 800,000 lbs. The general style

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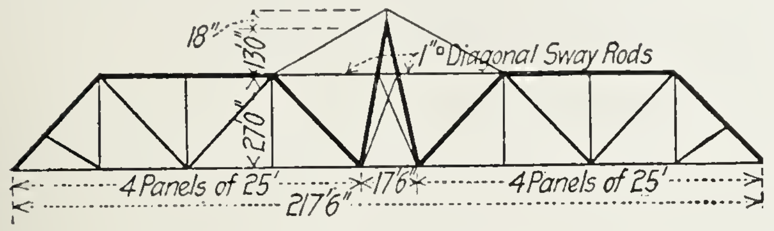
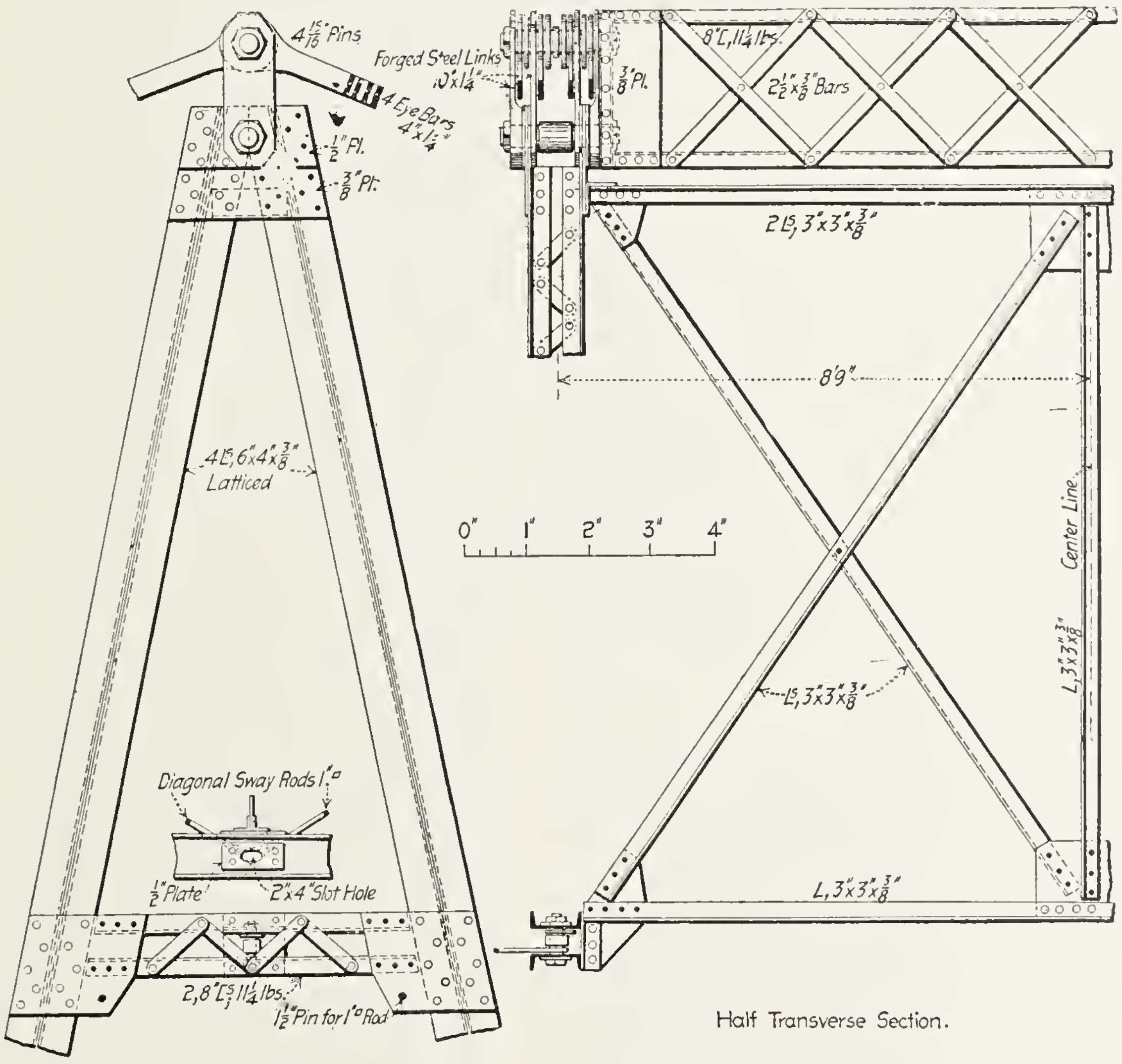
*From the Engineering News.

†Draughtsman Carnegie Steel Co., Pittsburg, Pa.



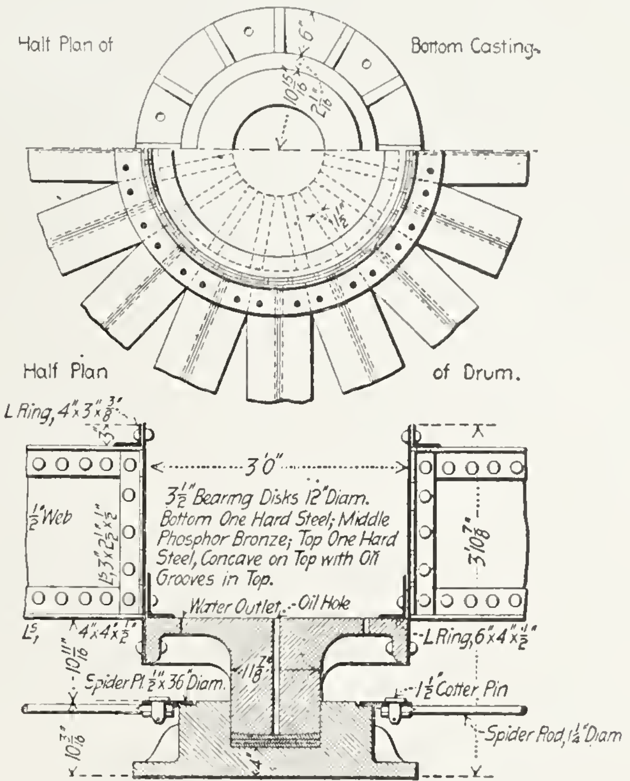
of construction is shown in the diagram, Fig. 1, and need not detain us except to say that all connections were riveted with the exception of the top laterals and the pin connections for the eye-bars and sway-rods connecting the trusses to the central tower. The peculiarities of the construction were three: The turntable centre, the central tower, and the end lifts. The design of the latter is the especial property of W. H. Law, of Toronto, at that time the engineer and manager of the company. The device is based on the use of the toggle-joint, is very simple to construct, and most effective in operation.

Central Tower.—In most swing bridges of ordinary types, whether rim or center bearing, we have to do in the ultimate analysis with beams of complete or partial continuity, and have to take care of shearing stresses transmitted across pivot or drum, and provide special devices to prevent hammering of the truss ends. In the bridge under consideration the rolling load can produce stresses only in the span on which it may be; and the trusses when closed may be figured as simple spans resting on their own supports and completely discontinuous. The turntable is surmounted by a braced tower, Fig. 2, on which rests forged steel links turning on 4 15-16 inch pins, and themselves carrying similar pins to receive the ends of the eye-bars. When the bridge is closed these eye-bars can receive no stress; when the bridge swings, the trusses are simply hung by them to the central tower—a form of construction most simple, effective and economical, easily computed and most practicable in the shop.


$4\frac{15}{16}$" Pins
Forged Steel Links $10"\times1\frac{1}{4}"$
4 Eye Bars $4"\times1\frac{1}{4}"$
$\frac{1}{2}$" Pl.
$\frac{3}{8}$" Pl.
$\frac{3}{8}$" Pl.
8" [, $11\frac{1}{4}$ lbs.
$2\frac{1}{2}"\times\frac{3}{8}"$ Bars
2 L's, $3"\times3"\times\frac{3}{8}"$
8'9"
4 L's, $6"\times4"\times\frac{3}{8}"$ Latticed
0" 1" 2" 3" 4"
Center Line
L, $3"\times3"\times\frac{3}{8}"$
L's, $3"\times3"\times\frac{3}{8}"$
Diagonal Sway Rods 1"□
$\frac{1}{2}$" Plate
$2"\times4"$ Slot Hole
2, 8" [, $11\frac{1}{4}$ lbs.
$1\frac{1}{2}$" Pin for 1"□ Rod
L, $3"\times3"\times\frac{3}{8}"$
Side Elevation.
Half Transverse Section.

It is quite possible, of course, that by some accident or other —a knock from a boat, say—the links at the top of the tower might be drawn over so far to one side as to fail to return to their normal position when the bridge is swung back to its position when closed. To obviate any mishap of this kind, diagonal sway rods 1 inch square are introduced extending from the pins at the hip to the central tower. Here they connect to 2 inch pins which travel in slotted holes 4 inches in length, giving each pin a movement of 1 inch each way from the center. These rods only come into play in the case of accident to the links, and are emergency safeguards and wind braces.

The central portal is double, as shown; one set of bracing acting with the links, the other set giving rigidity to the tower; the whole forming very efficient protection against accidents common to canals as well as against high winds.


Half Plan of Bottom Casting.
6"
$10\frac{15}{16}$"
$2\frac{1}{16}$"
$1\frac{1}{2}$"
Half Plan of Drum.
L Ring, $4"\times3"\times\frac{3}{8}"$
3'0"
$\frac{1}{2}$" Web
L's, $3"\times2\frac{1}{2}"\times\frac{1}{2}"$
$3\frac{1}{2}$" Bearing Disks 12" Diam. Bottom One Hard Steel; Middle Phosphor Bronze; Top One Hard Steel, Concave on Top with Oil Grooves in Top.
$3'10\frac{7}{8}"$
Water Outlet
Oil Hole
L's, $4"\times4"\times\frac{1}{2}"$
L Ring, $6"\times4"\times\frac{1}{2}"$
$10\frac{11}{16}$"
$11\frac{7}{8}$"
Spider Pl. $\frac{1}{2}"\times36"$ Diam.
$1\frac{1}{2}$" Cotter Pin
Spider Rod, $1\frac{1}{4}$" Diam
$10\frac{3}{16}$"
3'2"

Turntable Center.—This was designed for the express purpose of reducing shop cost by keeping the radial girders of full depth throughout their length. The load from the bridge is delivered to the drum by 16 radial girders which receive it from 8 bearing beams—that is, from 8 points of support. The turntable is combined rim and center bearing—and 250,000 lbs. reach the center, while 550,000 lbs. go to the 36 rollers. The center, Fig. 3, of cast-iron or steel, terminates in its own pin, and the form of construction reduces somewhat the amount of power required to turn the bridge; with this additional feature that the necessity of using bolts is entirely done away with. The steel center plate was riveted to the cast-iron center in the shop and the field riveting was then easily done without any special danger to the center.

The whole structure as thus designed merits attention from the manufacturer's standpoint, and its description may be of use in the further perfecting of shop detail, most centers being an outgrowth from the design of locomotive turntables, while this is an original creation out of hand.

THE EAST WILL BE EAST AND THE WEST BE WEST.

Editor CANADIAN ENGINEER :

Now that the convention held in Montreal last month is a thing of the past, I desire, whilst congratulating those who helped to make it such an immense success as it undoubtedly was, to draw your attention to one cloud, which though only the size of a man's hand at present might, if allowed to spread, assume dimensions great enough to swamp our whole association. I refer to the action at Thursday morning's session with regard to the matter of inspection, when it will be remembered one of the Toronto delegates, first premising that that city was not interested in the matter at all, proposed a committee of four to deal with the matter, consisting of three representatives of electric plant companies (two of which do not do wiring), and one alderman. I have no fault whatever to find with the gentlemen chosen, but I do object to the very class which of all others are interested, i. e., construction men, not being represented. This was pointed out clearly to the mover, and his courteous seconder even asked to add to the amendment such representative, only to be met with the curt rejoinder, "I persist in my motion." Now at the risk of appearing personal, of which I disclaim any intention, I consider the matter is of too great importance to the association to be "mealy mouthed," and therefore have to say (and I am not the only one), that for any member to carry such high handed proceedings, is a state of things the sooner remedied the better. We have bitter experience of West versus East in our own city without wishing to inaugurate it in our association, but I warn the members that if any clique attempts bull-dozing Quebec Province they will find that she is both able and willing to take care of her own interests, electrical and otherwise.

Whilst not altogether agreeing with the main motion I cannot but favorably contrast the fairness of its mover as compared with that of the mover of the amendment, in offering to withdraw his amendment provided a representative of a construction firm was added to the motion.

If the Toronto delegate's intention was to demonstrate that the association was only in the interests of electric plants, he is treading on still more dangerous ground, as the telephone and telegraph representatives will quickly prove to him, or if again, he intends to arrogate to himself the functions of a little pope he will find his following grow beautifully less, so far as this province is concerned, if he interferes in matters in which, admittedly, he has no interest whatever. I would like to ask you, sir, what is the total membership of the Electrical Association? What proportion of the Executive Committee are Ontario members and what Quebec? Apologizing for thus encroaching on your space. MONTREALER.

Montreal, July 4th, 1898.

ELECTRIC HEATING.

The inventions that have recently been put on the market by the Dominion Electric Heating & Supply Company, Ltd., of Ottawa, mark a distinct advance in electrical heating apparatus. The appliances manufactured by this company relate not only to house and car heating, but to domestic cooking, laundry work, tailoring and clothing manufacturing, hat manufacturing, and other branches of heating where gas and other fuel have hitherto been in use. A representative of The Canadian Engineer called at their works in Sussex street, and saw water boiled in seven minutes in kettles of a size similar to American electric kettles that require 15 to 18 minutes to bring water to the boiling point. The company guarantee to boil water in seven minutes at a voltage of 110. Like efficiency is obtained in their other heating devices. This high efficiency is attained by a new composition which, paradoxical as it may seem, is at once a good radiator and a good insulator, and which moreover will last infinitely longer than the enamel plates and disks hitherto used in electric heating apparatus. In the heaters hitherto in use all depends on the durability of the enamel. Once that becomes cracked or broken the efficiency of the utensil is soon impaired, and finally destroyed. The conductivity of the ordinary enamel disks is from eight to ten as compared with from fifty to fifty-five of the Dominion Heating Company's discs, which can be heated to a degree that would ruin an enamel disc in a few minutes. A test of one of the Dominion Company's discs was made by a continuous use for over a year night and day at a high temperature, and at the end of this time there was no sign of oxidation in the resistance coil. The composition used by the company has a dark and roughened surface and can be applied in such thin coats that there is very little resistance to heat through, which is one of the secrets of its efficiency. Over 2,000 various heaters have been manufactured by this company, and time is rapidly proving their superiority. The catalogue issued by the company describes electric frying pans, sauce pans, pancake griddles, flexible heaters for water bags, tea kettle heaters, chafing dishes, electric tea and coffee pots, broilers or toasters, cake cookers, portable stoves, glue pots, immersion plates for heating baths or wash water, curling tong heaters, tea and coffee urns, bar water urns, milk heaters, plate warmers, foot warmers, flat iron heaters, goose irons, air heaters for bath and other isolated rooms, electric office heaters, library radiators, as well as car heaters, cooking stoves, etc.

Peter McGregor, inventor of this special composition, was born in Glasgow, Scotland, and began to study electrical depositions and japanning while employed in the Milton foundry in that city. He afterwards learned the pottery business and was employed in Moreland's Castle Espie Works, in the county of Down, Ireland. Coming to Canada in 1873 he started the Ottawa Pottery Works in the following year. In 1879 he was awarded the bronze medal presented by the Princess Louis for original designs in pottery.

FRASER VALLEY RECLAMATION.*

BY R. E. PALMER, A.M. CAN. SOC. C.E.

The freshets or floods of the Fraser River, British Columbia, occur as a rule between the latter end of May and the middle of July, caused principally by the melting of the snow upon the mountains. In the reclamation of portions of the delta lands of this valley, from these freshets, the most difficult part of the schemes at present adopted is the satisfactory design and building of the sluice boxes and flood gates. Up to the present time, that portion of the delta reclaimed lies in patches, each portion being protected by itself, and not connected with any other portion. Generally these patches or valleys front on the main river, and are surrounded on all sides, with the exception of the frontage, by high lands, which discharge all their drainage upon the flats. This water finds its way over these flats through sloughs and creeks which discharge into the main river, during the low or ordinary stage of the water, namely, from August to the end of April.

The system of reclamation adopted up to the present day has been that of the construction of dykes or embankments, of different dimensions, along the banks of the river, from high lands to high lands, and of the building in the creeks or sloughs, over which the dykes would pass, of flood gates, and sluice boxes as they are called, which are so constructed as to close during the high water, preventing the river water from backing up the sloughs and flooding the prairies. They are constructed also to open, so soon as the water in the river begins to fall lower than in the sloughs, and drain the prairies, the sloughs during the period when the gates are closed acting as reservoirs, to hold the ordinary drainage from the surrounding hills. In ordinary cases the sloughs have not enough capacity to hold the drainage during the time when the gates are closed, and pumping has to be resorted to, for about a month in the year.

One of the most difficult operations connected with these schemes is the proper designing and construction of these boxes. It is a very difficult matter to keep them tight, and the material in and surrounding these sloughs is such that when once the slightest leakage occurs, under pressure, it is a very short time until the whole box finds its way into the river or up the slough. Again the many and varied kind of sloughs and creeks, the different classes of material through which they pass, varying from gravel and sand to silt and clay, the fact that some discharge into the river where there is a regular rise and fall due to the tide, while others discharge at points where the tide does not reach—(the gates of the former having of necessity to close and open during each tide, while in the latter they need only close during the freshet)—all tend to require very careful examination and much experience before deciding upon the proper design for the gates. In fact, almost every locality requires a gate of a design unique in itself, with some special features differing probably very materially from that required in a locality not half a mile distant. The boxes required for the sloughs located on the river above the effect of the tides are subjected to a very severe test and strain during high water. They are often subjected to a pressure of water due to a head of from 18 to 20 feet and lasting from a month to six weeks. On the other hand, those located on that part of the river affected by tidal waters are relieved twice every day during ebb tide.

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*A paper read before the Canadian Society of Civil Engineers.

The writer gives a description of two of these boxes built by him, one in March, April and May, and the other in August and September, 1896, all being under the same contract. They are built in two sloughs, discharging into the Fraser, through what is known as the Matsqui Prairie. They were designed in 1893 by Fred. J. L. Tytler, C.E., at present supervising engineer for reclaiming lands for the Provincial Government of British Columbia, and were built with several changes under contract by the writer. It may also be mentioned that in each of these sloughs prior to the construction of the ones described, there had been built three different and distinct boxes, each of which had succumbed to the effects of the freshets, and had been torn apart or scoured out, and carried by the flood for long distances over the prairies. One of the present boxes, the only one built at the time, was subjected to a very heavy freshet in July last, the water in the river reaching to a point only 2 feet 11 inches below that reached during the disastrous flood of 1894; but although the work was barely completed when the flood came, and had in consequence barely reached its true bearing, still there was no sign of leakage, or scour, or damage in any one particular. The lumber used in the boxes was all of rough sound cedar, with the exception of the clappers or doors, which were of dressed Douglas fir. The boxes are identical in design, each being 80 feet long by 26 feet wide by 5 feet 8 inches outside measurement, having four openings each 4 feet by 5 feet. They have also each an entrance apron 30 feet x 40 feet, and a discharge apron 60 feet x 40 feet; each contains about 90,000 feet B.M. All spikes were specified to be galvanized.

The most important part of the work is the method of setting the box, and the proper placing of the brush and clay and pickets, and this will be now described. At this point of the Fraser River, there is an ordinary rise and fall of tide, due to the backing up of the river, of about 4½ feet, while during the freshet no difference of rise and fall is perceptible. Both boxes being identical in design it is only necessary to describe the manner of placing one—the most difficult—and located in what is known as No. 3 slough. This slough is about 80 feet wide at the top, and from 25 to 30 feet deep, with water at the time of construction about 10 to 16 feet deep. It drains a large portion of the prairie, besides receiving a large creek from the surrounding hills, and as the weather was very wet at the time, it was necessary for it or the off-take ditch to carry away a large amount of water. The banks of the slough sloped at about ¾ to 1 and were interwoven with roots, and gave signs of sliding from adjacent springs and seepage of water. The method devised and afterwards adopted for placing the box was to build a temporary dam a short distance above the site of the box, another a short distance below the site, excavate an off-take ditch, and having pumped out the portion of the slough between the dams, to commence operations. The off-take ditch was excavated through fairly good clay, being about 12 feet wide at the bottom, with side slopes of about 1 to 1, and varying in depth from 4 to 14 feet. In constructing the upper dam a crib of logs was first built across, notched down and securely drift-bolted together, the logs on the upper side having a batter of about 6 inches to the foot. Along the upper side were driven sheet piles, consisting of 3 and 4 inches plank which penetrated from 4 to 8 feet into the bottom, but on account of the presence of many sunken logs and stumps, it was impossible to get all the plank down to a proper bearing, but they were intended merely to hold the brush and earth, afterwards conveyed in, from being swept down by the current so soon as it was deposited.

At first it was considered practicable to commence this sheet piling at one side, and continue along, finishing at the other, but it was found that the banks were of such a treacherous nature, that the increased current due to the narrowing of the channel, would scour away the banks more quickly than the sheet piles could be driven, and thus destroy the location of the box. It was then decided to commence at both ends, make them thoroughly secure, and work toward the centre. This was done, the sheet piling from each side being closely followed by laborers dumping earth to form an enbankment on the upper side of the crib, keeping plenty of brush on the outside, to prevent the earth being scoured away by the current. After having proceeded thus toward the centre, and when the current became too strong, due to the narrow opening to hold the earth from being washed oway, the gap in the sheet piling was closed, and the backing deposited as soon as possible. But the material in the bottom of the slough was of such a treacherous nature, that no sooner had the water on the upper side begun to rise on the piling than it broke through underneath, the water following the piles down, where it encountered a coarse, red sand, which was soon scoured out, and in a very short time an open channel was made underneath the piling. Sacks were immediately obtained and filled with earth (about 1,200 of them), and these dumped into the channel or hole with loose hay and earth, finally held the current until a large earth embankment was built across. No more trouble was afterwards encountered, although it was subjected at one time to a pressure due to a 27-foot head. The lower dam was built in much the same way, but with less difficulty, there being only a 4 foot tide to contend against. The specifications required all ooze, logs, sticks or perishable matter to be removed from the bottom of the slough, between the two dams, to a maximum depth of 6 feet below the bottom of the box, in order to secure a proper foundation on which to lay the brush and clay. Should the material below that be soft and mushy, then wild hay was to be tramped in below that again, until a firm bed was obtained. But it was to be left to the judgment of the engineer as to how deep up to the six feet the excavation was to be made.

After having pumped out the location—a centrifugal pump with a 4 inch discharge having been used with a maximum lift of about 15 feet—the bottom of the slough was carefully examined and the material tested. The first 2 feet or thereabouts consisted of ooze, slime, brush, logs, stumps and every imaginable kind of worthless matter. Beneath this for from 4 to 6 feet was a bed of silt, of a bluish color, containing minute particles of mica, and very gritty to the touch, but the particles of sand being fine. This when left in its natural bed, and not disturbed, is impervious to water, but once it is moved and displaced, and exposed to the action of water under pressure, it becomes a veritable quicksand. Beneath this was a bed of fairly coarse, red sand. After having made this examination, the cause of the former boxes having been scoured out was apparent to the writer. They had been constructed in the form of coffer-dams built by driving rows of sheet piles braced to ordinary piles, and filling the intervening space with earth or clay. These piles have penetrated this bluish silt, and were driven into the red sand. When the water acquired the necessary head on the outside, after the closing of the gates, it followed down the piles through the silt, into the sand and up again on the other side. The intervening earth was soon washed out, and with it the bottom of the piles, until a channel was formed underneath, and very little time elapsed before the whole structure was scoured out. After having been enlightened as to the nature of the bottom, it was decided to lay the foundation upon this bed of bluish silt, without disturbing it more than necessary. This was done after all the decayed material—logs, ooze, etc.—had been removed from the bottom, and all roots, slides and loose material cleaned off the sides of the banks, and proper slopes of about 1½ to 1 excavated from them. The foundation under the box proper was built up of clay and brush, that under each apron of rip-rap. The specifications for the clay read as follows: "To be of first-class quality, and when kneaded stiff into a pyramid of an inch or so in height, and immersed in water, will remain intact for 24 hours without crumbling. The brush was to be of green bushy fir or cedar trees, of young growth, not more than 15 feet in length, when the stem is cut close to the head, which it shall be, or limbs similar in character." The separate limbs were afterwards practically excluded, and bush allowed much longer than specified, which served the purpose better. The first intention of the writer was to obtain the clay from a bed about a mile up the slough, above the site of the box; but after the temporary dams had been built, a great quantity of rain fell, and as the off-take never was intended to carry off all the drainage, the water backed up, so that the clay could not be reached. Another bed of blue clay of excellent quality was then located on the river bank, about two miles below the mouth of the slough, and was conveyed by steamer and scows at a heavy expense.

The foundation was laid as follows: A bed of this clay was deposited on the bottom of the slough about 2 feet in thickness, and 80 feet in length, that is, under the site for the box proper. This was laid in layers a few inches in thickness, carefully spread and levelled, and well tramped and pounded down. On the top of this was laid a row of brush with butts to the end. These small trees were laid close together longitudinally, from one side of the slough to the other, and at one end of the foundation. The branches standing up were "nicked" in order to let them lie close. After the first row was laid, another was placed on top partially covering the first layer, similar to shingling a roof, butts all lying out in the same way as number one row. Then another row was laid in a similar manner, until the layer of clay below (80 feet in length) was covered for about two-thirds the distance from one end, or between 50 or 60 feet. After this had been completed, a layer of clay was laid on top from 1½ to 2 feet in thickness, covering the whole foundation. This was thoroughly compacted, and tramped down with horses and then levelled up. Upon the top of this clay was laid another layer of brush similar to the lower layer, but this time commencing at the opposite end of the foundation butts out, and extending for about two-thirds of the way towards the first end, and thus overlapping a portion of the first layer of brush, but care being taken that there was a good layer of clay between, so that the brush in no instance would be continuous through the entire length of the foundation. Upon the top of this was laid another layer of clay similar to the previous layer and so on, until the proper height was obtained to lay the box. When the foundation reached the required height, it was carefully levelled off and made ready for the box. The lower planks of the box floor (5 x 12 x 26 feet) were then laid close together, each one being levelled up and pounded down with a heavy pounder, until it lay on an even bed throughout, in contact with the clay. Upon the top of this floor was built the box as shown on the plan.

From the box to each bank of the slough was laid clay and brush in a similar manner to that in the foundation, care being taken that in no case should the brush extend in a continuous layer right through the embankment, or that it should touch the sides of the box. The clay was laid in thin layers and thoroughly tramped and pounded down, especially close to the box, and also carefully knitted into the banks on each side by key walls. A brush and clay embankment laid in this manner was carried up on each side and on the top of the box, until the top of the banks of the slough were reached, with the exception that, after the top of the box level was reached, the slopes on each end were carried up by driving split cedar pickets about 3 inches in diameter and 6 inches apart, 4 feet into the embankment—each row being 1 foot higher than the preceding one, and 1 foot nearer the centre of the box, thus making a slope of 1 to 1 at the ends. Behind, or inside each row of pickets, was laid "heading brush" or brush laid transversely with the box to keep the clay in place. From the top of the bank of the slough, a dyke of ordinary earth-work was built to the height of the river dyke, about two feet above maximum high water. The aprons were built as shown on the plan, the walls flaring out from the ends of the box to the end of the apron, and rip-rap being hand laid outside of the walls upon the floor, to load it down. From the rip-rap walls to the banks, the slopes were built of rough brush and ordinary earth, laid in a similar manner to the clay and brush.

The gates or clappers used on the box, are of the "top hung" pattern. A difference of opinion seems to exist among the engineers of this district, as to advantages derived from that style over the "side hung" gate. The trouble experienced with the gates on this box was as follows: when the freshet first begins to come, the river only rises a few inches in 24 hours, and, according to the state of the weather, may in its steady rise exceed 6 to 12 inches in one day. Consequently, the gates not being hung perpendicularly, but when closed have a batter of about 1 inch in 12—the water keeps running in underneath the clapper, filling the slough inside, as quickly or nearly so, as the river rises outside, and the clapper to all intents and purposes floats on the stream, there being practically no pressure against it, at least not enough to close it. Weights were attached to the bottom of the clapper which assisted materially in closing them. In the case where the water rises rapidly outside, as in tidal waters, no trouble is encountered, for once it begins to rise, a head very rapidly forms, and the gates will close with a sound as of the discharge of a cannon. Another disadvantage of the "top hung" gate is this: when the slough is discharging, the water inside as a rule is very slightly higher than the falling water outside. Also there are always more or less branches of fallen trees, sticks, pieces of logs, etc., being carried out through the boxes. These must necessarily pass underneath the slightly opened clappers, and in many cases are caught between the floor of the box and the bottom of the gate. Then when the tide changes, and the water turns to flow back into the slough, the debris prevents the particular gate from closing. Well designed grillages both above and below the gates ward off much of the debris, but notwithstanding this it is impossible to keep some branches, fence rails, etc., from passing through. In the "side-hung" gates, less trouble is encountered from this. Here the gates are hung in pairs, closing at the centre of the openings, the debris can then float upon the top of the water, and not being dragged along the bottom of the box, has only the two edges of the gates to encounter, and the gates being evenly balanced, will open enough to allow the debris to pass through. This difficulty of course is only encountered when the head on either side is small, and the gates in consequence are very slightly opened. In "side hung" gates there is a slight disadvantage in that it is very difficult to prevent the gates from sagging through length of time, which prevents them from closing tightly. They must be well designed with very heavy and strong hinges.

In many of these boxes on the Fraser, the gates are hung on the outside of the box, and have an advantage that they are more easily reached should anything prevent their closing during high water.

These gates cost practically $10,000 each.

SEWAGE DISPOSAL.

Editor Canadian Engineer.

My attention has been drawn to a letter signed "Expert," which appears on pages 47 and 48 of The Canadian Engineer of June, 1898, containing mis-statements and inaccuracies with respect to the International system of sewage purification, which for ten years has been in this country so successfully used, and adopted in preference to all other methods, and is now being introduced into Canada and America by Mr. J. McDougall. It is evident that "Expert," who prefers to make his assertions anonymously, is not master of the subject on which he writes. His statement that the International Company has changed its filtering process from a continuous flow to an intermittent system, "thereby purifying the sewage by bacteria, which require atmospheric air regularly at short periods," is not correct, as the International Company has always recommended, and was the first to introduce, the now accepted principle that filter beds must be worked on an aerating system in order to ensure the best results. At the present time, by means of valuable patented improvements, we are able to aerate filters every few minutes, and at the same time filter at a much greater speed than any other process, and obtain a far higher degree of purity. "Expert" also makes some rash and totally incorrect statements as regards what he calls "Intricate sludge machinery." The sludge removal apparatus used in the International process is of the most simple and efficient kind, effecting great economy in the construction of sewage works, as its use does away with the necessity of large areas of tanks. The apparatus is used by the British Government, and at a great number of sewage works in this country, and its adoption is rapidly extending, which fact is proof of its success. "Expert" also says the precipitant Ferozone is a "heavy constant and useless expense," and that coal screenings are far superior to Polarite—(the filtering material of the International process). These assertions are so wholly incorrect that it is difficult to understand how "Expert" came to make them unless he wishes wilfully to mislead. As regards the cost of Ferozone, with modern plant and machinery and with a dilute sewage such as met with in American and Canadian towns, chemicals may be dispensed with altogether, there being sufficient dissolved oxygen in a weak sewage to effect the necessary treatment in the sewage tanks, previous to the final purification through Polarite beds. "Expert" rashly says, "Coal screenings are far more efficient and lasting when used as a filtrate, standing ahead of every other material, except charcoal made from wood or town's garbage." The only advocates of charcoal made from town's garbage are those interested in what was known in England some years ago as the Jagger & Turley system of carbonized refuse, which was tried at a little place called Baildon, the results being given in a paper read by W. Naylor, Esq., F.C.S., chief engineer inspector, Ribble Conservancy Board, and published in The Journal of the Society of Chemical Industry, 30th April, 1894; the following is an extract, and will show the utter absurdity of attempting to deal with sewage by such a system:

"An impression has long been abroad among the local board 'Practical men' that coke is the proper thing through which to filter sewage. Reason and figures are of no avail with a sewerage chairman, who has set his mind on coke. It is an old established institution, handed down from father to son, and will die hard, but die it must, for (as shown by the Nelson figures, Nos. 32 and 33) it has no effect on dissolved organic matter at ordinary filter depths and rates of filtration. This coke, however, was pulled out and burnt during a recent coal famine, doing more good on that particular occasion than it ever did before. Its ghost, however, is now on exhibition at Baildon in the form of a 'Carbon' filter (so-called). Ash pit and privy refuse is here burnt, carbonized, it is claimed, and a filter made of the resulting ash. This forms a sand filter, but that is all, and if of sufficient area would perhaps in time form a nitrification bed. This is a process which at once appeals to the minds and pockets of local boards. No precipitants! No expensive filters! Refuse disposed of! No pollution! The impossibility, however, of its application on a large scale must be apparent at once to any but an outsider. The sewage treated at Baildon by this process is initially very weak. Its effect upon that is a mere screening effect, as shown by the results numbered 34 to 37."*

TABLE OF RESULTS.

No. of sample.	Description of sample.	Taken by	Date	Examined by	Part per 100.000 albumenoid ammonia.
32	Nelson effluent before coke beds	Author	8th Aug., '92	Author	2.0
33	do. after	"	"	"	2.0
34	Baildon raw sewage	"	17th Jan., '94	"	0.345
35	" tank effluent	"	"	"	0.330
36	" filter	"	"	"	0.150
37	" clear sewage	"	"	"	0.130

It is evident that your correspondent, who styles himself an "Expert," is woefully ignorant, not only of the science of sewage treatment, but of what has recently taken place as regards the system he indirectly advocates, viz., carbonized town garbage, which after trial had to be abandoned at the town of Alton, Hampshire, England. Is not "Expert" connected with this carbonized garbage process. Otherwise his unjustifiable attack on the successful International system cannot be understood. Polarite filters are vastly cheaper than any other form owing to the powerful purifying powers of Polarite, which enables a high rate of filtration to be maintained and an effluent of a much greater degree of purity obtained than by any other system. The best proof of this is the number of places at which Polarite filters are in operation. Her Majesty's Government would not use Polarite in England and send it to all parts of the world for purification purposes, could equal results be obtained by coal screenings, coke or similar substances, which when tried, even on a small and closely watched experimental scale, are found after a short time to choke up and become useless, even when worked at so slow a rate of filtration as to render them enormously costly and altogether prohibitive. Polarite filters on the contrary are most economical and their efficiency is shown by the following, which is the opinion of Major Tulloch, C.B., R.E., late engineer in chief to the local government board, on the Chorley Corporation Sewage Works, where the International Ferozone and Polarite process has been in most successful operation for several years:—

"I am highly pleased with what I have seen. The works are excellently managed and looked after, and reflect the greatest credit on the town council. The effluent from the depositing tanks is among the very best I have seen, almost perfectly clear, and with only a faint smell, while that from the filters is as clear as spring water and perfectly inodorous. These works I consider to be among the very best in the country. I know of none where better results are produced."

In view of the anonymous attack made on the International system by "Expert," I trust that your Canadian sense of fairness will ensure the fullest publicity to this letter, for the length of which I apologize, and remain, yours obediently,

FRANK CANDY,
General Manager.

109 Victoria Street, Westminster, London, England.
July 8th, 1898.

GARBAGE DESTRUCTORS.

Editor CANADIAN ENGINEER:

Our attention has been drawn to a letter signed "Expert" in your June issue, and this gentleman mentions the name of our Mr. Warner and the Patent Refuse Destructor, which we manufacture, and we think it necessary to make some comment upon the matter. It is evident to us that this expert is a very dark horse, as in the first place he does not acknowledge his name, and in the second place, he does not know what he is talking about. If he would give his name, facts and figures it could be handled in a proper engineering manner, but, it may be as well to mention that we manufacture several kinds of destructors, both with forced draught, by steam and air blast and with chimney draught, that we are up to the most recent destructors as regards high temperature, cost of refuse treatment and the amount of steam produced, and as some proof of our statement we enclose a reprint from a recent English newspaper showing that after full investigation our patent destructor has been accepted at the city of Bath, the city of Sheffield, and the town of Plymouth. We have since been informed that the town of Hartlepool has passed our scheme for a destructor of 6 cells, and we are at the present time building destructors in different parts of the country and abroad, consisting of upwards of 150 cells; this, we think, is practical proof that our schemes are not so old-fashioned as made out by "Expert." We can say quite as much with regard to the treatment of sewage as we are at the present time supplying a large number of the most important schemes, and carried out under the most eminent engineers including J. Mansergh, Esq., of Westminster; W. Santo Crimp, Esq., T. de Courcy Meade, Esq., Mr. Leiley, Messrs. Pollard & Tingle, of Westminster, and many other borough engineers. In conclusion we can only say we think "Expert" will have to be a student for many years before he arrives at a possible chance of being a professional man, let alone an expert in matters he is talking about. Yours truly,

GODDARD, MASSEY & WARNER.
Nottingham, Eng., July 15th.

SANITARY PLUMBING.

Editor CANADIAN ENGINEER.

I have read with much pleasure W. M. Watson's article on the sanitary experiments at Cologne, and since reading it I have been able to prove the accuracy of the statement that sewage falling vertically through a soil pipe carries down with it several times its own volume of atmospheric air into the main sewer, which is a very important thing and tends to keep the sewers fresh and odorless. I have worked in three of the largest cities in England as a journeyman plumber, where interception traps on private drains or on drains serving rain water leaders were unknown. No more was sewer gas known to enter dwellings or pollute the streets in such quantities as to be injurious or noticeable. I have also worked in Toronto where traps are in general use for such purposes, and when doing repairing work I have found many chokes, and several buildings with the soil under the basement floors completely saturated with the liquid from excrement, which is a mishap that never occurred in any of the towns in which I worked in

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*Reprinted from the Journal of the Society of Chemical Industry of 30th April, 1894. Being a paper called "Comparative results of some modern systems of Sewage Treatment," by W. Naylor, F.C.S., Chief Engineering Inspector to the Ribble Conservancy.

England, where sound drains are used. The article has given valuable pointers to thinking plumbers and unbiased citizens who wish to secure the healthiest methods of erecting sanitary appliances. Truly yours, E. A.

Napanee, July 25th, 1898.

WILLIAM HENRY LYNCH.

William Henry Lynch was born at Danville, Que., July 25th, 1847. In his youth he worked as a telegraph operator and was afterwards manager of the old Danville school-slate quarry. When the quarry closed down though the lowering of prices, brought about by American competition, Mr. Lynch turned his attention to the dairy question. Under a strong conviction of the great future before the dairy interests of Canada, and the special suitability of the climate and soil of this country for this branch of agriculture Mr. Lynch began an agitation throughout the country for a reform in the methods then in vogue. From 1881 to 1889 he spent most of his time and money in efforts to arouse the attention of the farmers to the great opportunities before them in the manufacture of butter and cheese for export. He applied himself so intensely to this labor of love that he soon became one of the foremost authorities on dairying. His work attracted the attention of the late Prof. Arnold, of Rochester, who invited him there to carry on experiments in the treatment of milk and the manufacture of butter, and who returned the obligation by coming to Canada to testify to Mr. Lynch's great work in the interests of the Canadian farmer. During this time Mr. Lynch became the author of a book on "Scientific Butter Making," the value of which was manifest by its purchase by the Ontario Government for general distribution among the Ontario farmers. Among the direct results of this work was the establishment of a government creamery, and the incorporation of dairy work as a special department of the Agricultural College at Guelph. "Scientific Butter Making" was followed by "Butter and Cheese," of which 70,000 copies were issued in English and French. The edition was exhausted within a year, and this led to a larger work entitled "Scientific Dairy Practice," which is considered to-day the best hand-book ever issued on this subject, and of which 100,000 copies were printed. During these years Mr. Lynch delivered hundreds of public lectures to farmer's and dairymen's associations, besides addresses to various Boards of Trade throughout Canada. These were delivered without charge and in most cases without even compensation for his traveling expenses, his great work being carried on simply out of conviction of the importance of the subject to the country. That Mr. Lynch looked into the future with a prescient eye is very evident, when we consider the enormous development of the dairy exports of Canada. In 1886 the exports of Canadian cheese amounted to $6,754,620, and of butter $832,355. In 1897 the exports of Canadian cheese amounted to 164,220,699 lbs., valued at $14,676,239, and of butter to $2,089,173. To see what was being accomplished by other countries, Mr. Lynch made a tour at his own expense through Great Britain, Denmark, Norway, Sweden, Holland and Germany, and gave the results of his knowledge to the public in a series of interesting letters, written also without charge, to the leading Canadian papers. He had all along urged federal action by the Canadian Government to promote the export of dairy products, and closed his letters by a call to Canadian dairymen to meet in a convention at Ottawa. The immediate outcome of this convention was the appointment of a Dominion dairy commissioner, and the organization of the govermental machinery, under which our exports of dairy products have since increased with such remarkable strides. Mr. Lynch could have had the appointment of dairy commissioner, but it is in keeping with his character that he declined to reap to his own personal advantage where he had sown so generously. When it is known that he also declined a like appointment offered to him by a foreign government, simply because he did not wish to educate a foreign nation to compete with Canada, and when it is realized that his education of the Canadian farmers has meant millions of dollars in the pockets of the Canadian people, William Henry Lynch may well be enrolled among the Canadian patriots, whose names should pass into history. He was one of the founders of the Canadian Dairyman (the first paper in this country exclusively devoted to dairying), which was afterwards merged into the Rural Canadian. For some years past Mr. Lynch has devoted much attention to mining, being among the first to realize the importance of the developments in British Columbia. He made some suggestions for the improvement of the B.C. mining laws, which, had they been acted on, would have prevented some of the abuses that now exist there.

Mr. Lynch has now been entrusted by the Minister of the Interior with a commission to make a special study of the local condition of the Canadian Yukon district, particularly as to the mining regulations, and to report to Ottawa. Being an original thinker, as well as a man of high ideals, he is not likely to be tied down by precedent, and we may expect that his investigations will result in a code of mining regulations, which while conserving the public interests will give to the honest miner the fullest security, and make the Canadian Yukon a model mining region.

THE CANADIAN MUTUAL AID ASSOCIATION OF MECHANCIAL ENGINEERS OF THE PROVINCE OF QUEBEC.

This association has sent out the following circular to manufacturers: "With a view to securing to manufacturers the advantage of obtaining experienced persons to take charge of steam plants, the mechanical engineers have formed an association which will accept as members only those who are licensed, and firemen who have a thorough knowledge. This association deserves much encouragement because it makes continually a special study of all questions relating to steam machinery, both as to economy and safety. It has also for its aim the mutual aid of its members in case of sickness, and differs from many other societies in that it does not interfere in any way with salaries. Having been founded as much in the interests of the proprietors of steam machinery as of the mechanical engineers themselves, they count on those interested in carrying out these two nobler aims. The president of the association will be most happy to reply to correspondence from engineers and firemen, and will furnish either by letter or personally any information having reference to steam machinery." The circular is signed by Ephrem F. Valiquet, 106 Bourget Street, the president of the association, and is dated from The Mechanical Engineers' Rooms, 392 Lagauchetiere Street, Montreal.

—Bond & Smith, architects, Temple Building, Toronto, are calling for tenders for the reconstruction of a residence on Lowther avenue, Toronto.

—An interesting test has just been completed by James Lang at the power house of the Toronto Railway Co with a view to getting at the actual results of a mechanical stoker as compared with hand firing. The test was made on an improved Jones underfeed mechanical stoker for three days, resulting in a saving of fuel of 15.2 per cent., or an increased evaporation for equal fuel of 17.93 per cent. Minute details of the test are being printed by the General Engineering Co., of Ontario, Canada Life building, Toronto, who will forward the report to those interested in the subject.

"STERLING" HACK SAWS.

Every good mechanic is interested in learning of any new line that will prove to be a labor saver in his work, and the "Sterling" Hack Saw Blade, which has acquired great popularity in the United States is now being freely sold throughout Canada, and used in a large number of the best machine shops. The cost of these blades is less than the value of time spent in filing the old-fashioned blades, which were not tempered. The teeth of these saws are made with a file temper so as to cut through the hardest tool steel, and can be bought at a price so low that it does not pay to waste time in filing saws as had to be done before the tempering of hack saws was reduced to a science, as it now is. The efficiency of these saws is shown by the following tests:

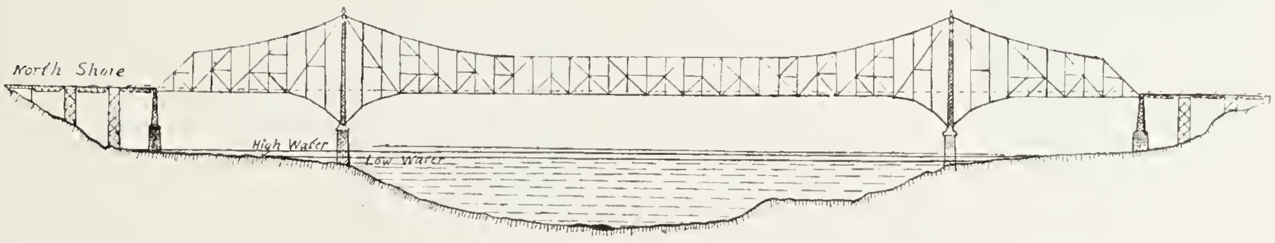
I hereby certify that I was present at a test of the "Sterling" hack saw blade in a 12-inch power saw; that it made 28 clean, even cuts off a bar of Jessop's tool steel; in addition it cut 1 piece 6 in.x5-16 in. machinery steel; 1 piece 3¼ in.x5-16 in. machinery steel; 1 piece 2 in.x5-16 in. machinery steel. Having tried every hack saw blade on the market, I consider the "Sterling" hack saw superior to any blade I ever used.

J. F. Chamberlain,
Superintendent Burgess Arms Co.
Buffalo, N. Y., March 21st. 1898.

I was present at the Burgess Arms Co.'s plant when the "Sterling" hack saws were being tested in their 12-inch power machine. The test was very satisfactory, cutting 28 to 30 cuts through 1 inch square Jessop's unannealed tool steel; also cutting 11½ in.x5-16 in. machinery steel without breaking. Another saw I used cut through 1 bar 2-inch round, 1 bar 1¼ in.x4 in., 1 bar 2x3 in., 1 bar 3½ in. round, half through, all being unannealed tool steel, saw still unbroken. I consider the "Sterling" equal to any saw in the market. Truly yours,

C. H. Choate,
Tool Maker, Burgess Arms Co.
Buffalo, N. Y., March 21st, 1898.

THE PROPOSED QUEBEC BRIDGE.



Distance between base lines, 2,546.07 feet, from centre to centre of piers, 1,600 feet; between back walls, 3,300 feet; clearance for navigation, 150 feet above high water mark. E. A. Hoar, C. E., is the engineer in charge. Tenders will be called for till Sept. 1st.

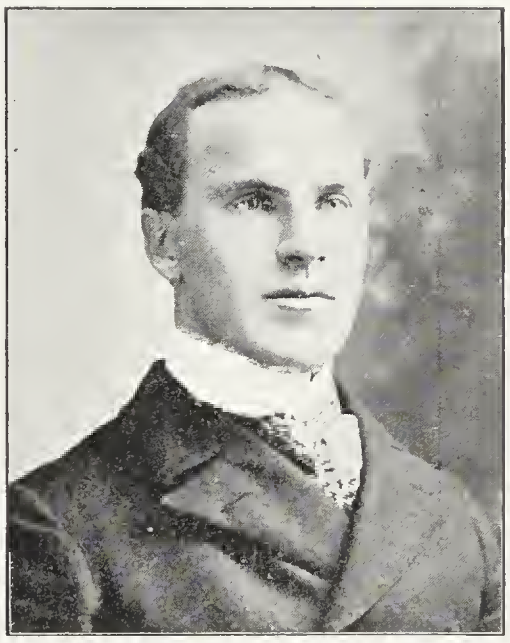
FIRES OF THE MONTH.

July 2nd. The Ashbourne flour mill near Bullock's Corners, Wentworth county, Ont.; loss, $10,000; insurance, $8,000.——July 7th. Saw mill owned by Biecher Tingley, Moncton, N.B.——July 8th. The Mastigouche Lumber Co.'s mills, St. Gabriel de Brandon, Que.; loss, $20,000; insurance, $9,000.——July 10th. Saw mill owned by Daniel Richards, Campbelltown, N. B.; loss, $20,000; insurance about $10,000.——July 11th. The Berlin Brush Co.; partially insured.——July 12th. C. Smith's foundry, Durham, Ont.; loss, $2,500; insurance, $800.——July 13th. The Maritime Sulphite Fibre Co.'s barking mill, Chatham, N. B.; loss, $1,000.——July 15th. The Sherbrooke Iron Works; slightly damaged.——July 17th. The Tilbury, Ont., electric light plant.——July 20th. N. Cayonette's saw mill, Ste. Moise, Que.; total loss; G. Ross and his son, watchmen, were found burned to death.——July 22nd. The Macdonald Tinware Co.'s factory, Montreal; damages, $15,000.——July 26th. Steamer "D. L. Mather," owned by the Keewatin Lumber Co., burned at Winnipeg; loss, $8,000.—— July 27th. The Linotype Machine Co.'s works, Montreal; loss, $70,000, fully insured.——July 30th. Adam Haines' furniture factory and saw mill, Waterville, Que.; loss about $10,000.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

The ninth annual convention of the Canadian Association of Stationary Engineers will be held in Hamilton, Ont., Aug. 8th. The convention will open on Aug. 8th at 11 o'clock, when the Mayor of Hamilton will welcome the delegates to the city. Committees will be appointed and the convention will then adjourn till 10 o'clock on the 9th, when a business session will be held, followed by an aquatic excursion in the afternoon. In the evening E. G. Barrow, C.E., city engineer of Hamilton, will read a paper on "Sewage Disposal," and J. S. Williams, analyst for J. Winer & Co., will read a paper on "Oils in the Engine Room." On Wednesday, Aug. 10th, business sessions will be held. In the evening the annual banquet will be held at the Waldorf.

GORDON J. HENDERSON.



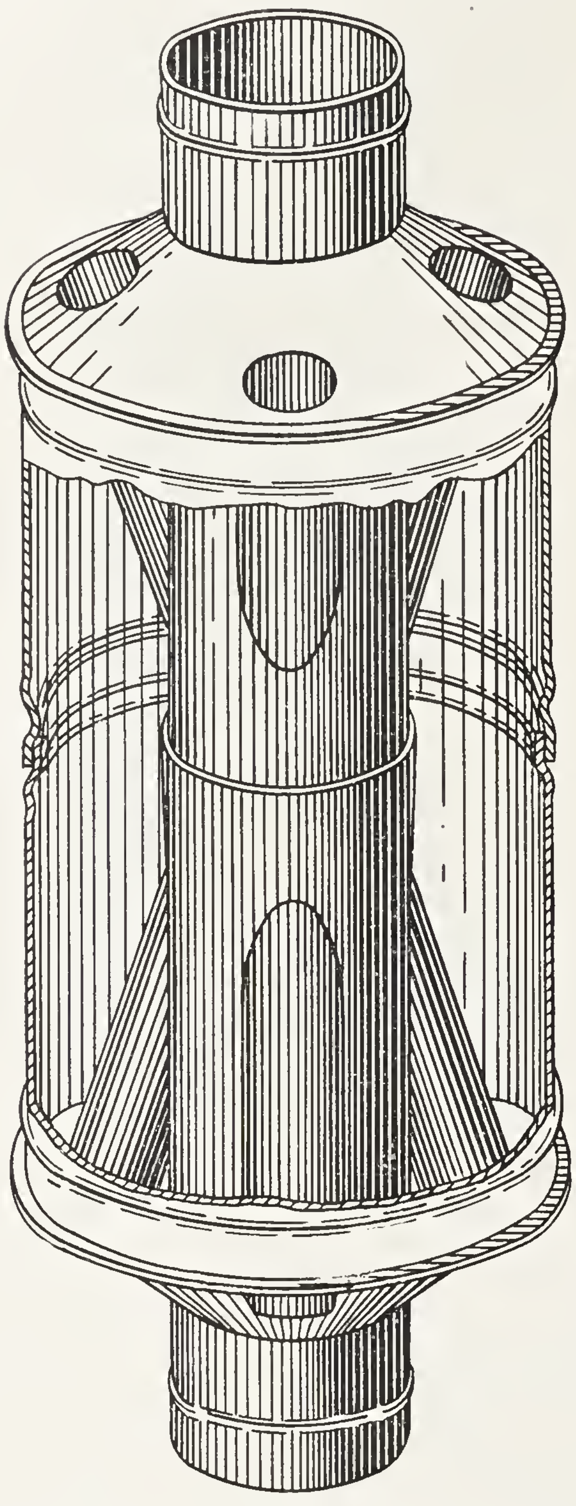
The manager of the Hamilton Electric Light and Power Co., ltd., Gordon J. Henderson, was born in Montreal in 1871, being the son of David H. Henderson, a well-known lumber and timber merchant of that place. Mr. Henderson was six years with his brother, C. W. Henderson, electrical contractor and general supplies, and has been connected with the present company for two years. He has been fortunate in putting this company on a paying basis, as it is a well-known fact that for six years previous to his being appointed manager, it had never paid any dividends. The revenue both from power and incandescent has very materially increased, and expenses all through show a marked decrease. We hope Mr. Henderson will long continue his present successful work. At the recent convention of the Canadian Electrical Association, Montreal, Mr. Henderson was elected a member of the Executive Committee.

THE CHILCOOT HOT AIR HEATING DRUM.

By W. M. Watson.

The coal used in many sections of the country must be imported, which drains the country of its wealth and advances the price of fuel to such an amount that it is necessary to adopt any appliance that will extract an extra amount of heat from the fuel. The majority of hot air furnaces, heating and cooking stoves allow one to two-thirds of the heat from the fire to escape up the chimney unused. The inventor of the Chilcoot Hot Air Heating Drum has clearly shown how much of the formerly wasted heat can now be utilized and made to cause a healthy circulation of warm air in rooms that otherwise would be obliged to have either a hot air pipe or an extra stove to make them comfortable.

Single and double smoke drums have been long in general use and have radiated into rooms quantities of heat in proportion to the exposed surface of the smoke drum, to the distance the drum was placed away from the fire, also the temperature of the fire and the strength of the air draft passing through the fire. It must be borne in mind a coal fire allows its heat to be extracted from it by the iron and brick work that surrounds the fire, while a fire made of wood is inclined to travel a long way beyond the seat of the fire if allowed to do so, and the smoke drums and pipes of a wood fire will radiate a large share of the heat made in the stove. But no coal fire can burn or be kept alive without some draught of air passing through it which causes the part of the heat of the fire to pass up through the smoke pipes to be discharged into the outside air, unless arrested and radiated into the living rooms by a smoke drum.



It is found that it takes about five times the quantity of heat to raise a volume of water or air ten degrees in temperature more than it does to raise it five degrees, and the difficulty of heating air or water becomes more as the temperature increases. By passing a thin stream of cold water or air over a hot plate at a reasonable rate, about twenty times the number of cubic feet would be heated to a given temperature in a stated time than if the whole quantity of water or air to be heated was collected into one large vessel, and a furnace placed in the centre or under it. Heating the water or air in a thin stream is called heating by circulation. Heating by bulk is called heating by radiation. The fuel that will heat to a temperature of 60 degrees will have to be increased in far greater proportions to raise the heat of the same rooms to 70 degrees. This shows the necessity of using the Chilcoot Hot Air Heating Drum, which combines the two systems of heating in one article. The outside casing or shell radiates quite as much heat as any of the drums formerly used. Then the air of the room is kept in a lively and healthy motion by rapidly passing through an inner drum connected by three collecting and distributing tubes acting similarly to tubes in hot air furnaces. The Chilcoot Hot Air Heater is really a secondary furnace.

The patent rights of this valuable article are for sale by S. J. Robertson, 62 Church Street, Toronto.

LITERARY NOTES.

A very interesting and attractive booklet, " Montreal Homes, Hints to Intending Builders," has been sent us by the author, Arthur J. Cooke, architect, Montreal. It contains a number of illustrations and many suggestions of great value to the intending house owner.

The annual reports of the several departments of the civic government of Halifax, N.S., for 1896-7 have reached us from the office of the city engineer, F. W. W. Doan. A great mass of information, much of it minute in detail, is given. The work of the year in all the departments of the city government is described. The city engineer thus sums up the difficulties of city improvement: " There is a great difference in foremen and the number who can be relied on for cheap work is limited. We are expected to employ men, simply because they are citizens of Halifax, whom no city contractor would have on his work. Such a system is useless and extravagant, if the taxpayer is to get one hundred cents for every dollar expended. The very men that claim that such men are not employed are the first to complain that there is nothing to show for the expenditure. The Works Department is not a Charity Board, and must be run on business principles. Good men can be obtained in Halifax and we should be permitted to select the best. The results during the last three years show what can be done by good men, and the standard set up should be maintained. The accounts of the Clerk of Works tell the story more forcibly than it can be expressed here."

Very few who are engaged actively in the mineral industry are able to find time to read up extensively in technical literature, however much they realize the importance of being fully and accurately informed on all that is going on about them in their own branch of industry. Such busy people will eagerly welcome " The Mineral Industry," each year as it appears from the press, for they find in it a maximum of the information that they need, at a minimum of expense both of money and time. An outline of the table of contents shows the broad field covered by volume VI. This volume contains a review of the production of abrasive materials and their uses, including carborundum, corundum, crushed steel, diatomaceous earth, emery, garnet, grindstones, pumice, quartz crystal, tripoli and whetstones. Special articles on Carborundum, by E. G. Acheson; The Garnet Industry of the United States, by F. C. Hooper, and the Volcanic Ash Deposits of Nebraska, by Erwin H. Barbour. The Mineral Industry, published by the Scientific Publishing Co., 253 Broadway, New York; price, $5.

The " Engineer's Hand Book," just published under the auspices of the Canadian Association of Stationary Engineers, is a handy pocket volume of 286 pages, and contains about 130 pages of tables and information for every day use by steam users, engineers and firemen. Besides a vast amount of data for engineers it contains a short history of the association and its aims. J. G. Robertson, the Executive secretary, assisted by J. J. York, O. E. Granberg, B. A. York and R. A. Ross, E.E., are named as the principal compilers, and well they have done their work It would be hard to find a book in which so much information is packed into so small a compass.

" Friction and Lubrication " is a pamphlet published by the Joseph Dixon Crucible Co., Jersey City, U. S., which describes the excellencies claimed for the preparations of graphite placed on the market by this company. There is also issued by the same company "Graphite as a Lubricant," which treats more extensively of the same subject.

The Ingersoll-Sergeant Drill Co. has issued a new catalogue, No. 32, which illustrates and describes the air compressors built by this company. Separate pamphlets are also issued to describe special installations. One of these describes the plant of the contractor of the Jerome Park Reservoir, New York, who has adopted a compressed air system. The work of excavation involves the removal of over 7,000,000 cubic yards of material, about half of which is rock. The field of operations covers an area of 1½ miles by ¾ of a mile. A compressed air plant is located at a central point and pipe lines are laid to the points where the work is to be done. At these points are located hoists, pumps, drills and other conveniences for the work, all of which is described in a pamphlet sent out by the company. The Jas. Cooper Mfg. Co., ltd., Montreal, builds this machinery in Canada and Newfoundland.

We have received a very instructive book on "Water and Water Supplies," by John C. Thresh, D. Sc. (London), M.D. (Victoria), Ph. D. (Cambridge), Medical Health Officer to the Essex County Council, Lecturer on Public Health, King's College, London; Editor of the Journal of State Medicine, Hon. Sec. Incorporated Society of Medical Officers of Health, Fellow of the Institute of Chemistry, member of the Society of Public Analysts, etc., etc. The book contains 438 pages, besides a number of illustrations of machinery and appliances, which are of great value. It fully explains and carefully describes the properties and composition of waters, rain and rain water, surface water, subsoil water, natural spring water, deep well water, river water, quality of drinking water, etc. Impure water and its effect upon the health is discussed and the interpretation of water analysis and the pollution of drinking water. The self purification of rivers, the purification of water on a large scale, domestic purification and the softening of hard water are taken up. The quantity of water required for domestic and other purposes, how to select the source of supply wells and how to construct them, pumps of the best kind and pumping machinery, the storage of water, the distribution of water, the law relating to water supplies in Great Britain, are among the other subjects discussed, together with a vast amount of important information necessary for engineers and persons interested in towns or domestic water supplies.

Industrial Notes.

A new public hall will shortly be erected at Millerton, N.B.

The St. Vincent de Paul hospital at Brockville, Ont., will cost $4,000.

The Bushnell Oil Co., Sarnia, Ont., has bought the receiving tanks at Bothwell.

A new hotel to take the place of the burned Clifton House, Niagara Falls, Ont., will probably be erected at a cost of $500,000.

Jno. McGuirl, who was burnt out at Moosomin, Assa., with heavy loss some time ago, will rebuild his wood working factory.

The masons are making good progress with the new buildings of the Deseronto, Ont., Iron Company, and the walls are steadily rising. The carpenters are also at work.

The contract for alterations and additions to the Brantford, Ont., Box Company's works has been let to P. H. Secord. The work is to be completed by 15th September.

The Rathbun Company, Deseronto, Ont., has cleared the ground of the debris caused by the burning of their terra cotta works, preparatory to the erection of new buildings.

D. F. Maxwell, C.E., has been ordered by the St. John City Council to prepare plans for the proposed wharf extension, which are to be filed with the Dominion Government.

The Hamilton Bridge Works, Hamilton, Ont., is very busy and intends to increase its staff. It recently advertised on one day for a stationary engineer, two blacksmiths, four machinists, two punchers and two air riveters.

A. Kellar, Detroit, Mich., wants a free site and a loan of $5,000, in consideration of which he will move the business of the Michigan Heater Co., of Detroit, to Winnipeg. The company is engaged in the manufacture of stoves and furnaces.

J. H. Connor & Son have just completed a new washing machine factory in Jane street, Ottawa. It is three stories high and is operated by two electric motors. The productions of the new factory will be washers and wringers. The damage reported in the firm's late fire was greatly exaggerated, the actual loss being only about $600.

The contract between F. Thompson & Company and Lennoxville, Que., for the building of a system of waterworks for the village of Lennoxville, was signed July 27th, and work was commenced upon the undertaking the next day.

Thos. H. Murphy has purchased from the St. Clair Tunnel Co. all the air locks, rams and fittings used in the construction of the tunnel under the St. Clair. The plant will be used in the contract for the construction of the drainage tunnel in Chicago.

B. D. Hanna, of the Dauphin Railway, has secured some samples of red oxide which were found by a Dauphin man about twenty miles south of Birch Island, in Lake Winnipegosis, Manitoba. If the quality is good the deposits will be of immense value, as there are great quantities of it.

The Shawinigan Water and Power Co. is offering special inducements to manufacturers to locate on the St. Maurice River, Que. Large limits of power may be secured, as this is one of the largest powers in Canada. Information may be had from the company, 1724 Notre Dame Street, Montreal.

Engineer Hibbard, who took soundings for a new bridge at Arnprior, Ont., has sent a report to the town council recommending a two-span bridge with one pier, along with the usual abutments. The cost is estimated to be in the neighborhood of $10,000.

A. Rosseau & Co., Montreal, have been awarded the contract by the city of Quebec for the bridge to replace Bickell's bridge, together with the dam, for the sum of $23,000. The dam or lock is intended to keep the water at a uniform height of twelve feet at low tide around the Victoria Park.

The necessary stock has been subscribed for the proposed scissors factory in Brantford, Ont., occupying a portion of the old Waterous building. The provisional directors are: J. F. Watt, W. R. Turnbull, R. W. Robertson, George Heyd and W. F. Cockshutt.

The annual report of the city engineer of Halifax, N.S., shows that the city water mains have been carefully cleaned during the year, the Kennedy-Keating scraper being used. The engineer also comments on the fact that no progress has been made in the proposed garbage disposal works during the year.

Rhodes, Curry Co., Amherst, N. S., have been awarded the contract for building the Intercolonial Railway pier and sheds in Halifax. The pier will be 600 feet long by 160 feet wide. The plans are completed for the elevator and Hon. W. S. Fielding is said to have promised that the elevator will be open by Dec. 1st.

The committee considering the sewage question in London, Ont., has reported to the city council in favor of the system of the International Sewage Purification Company, Detroit. The plant is to cost $41,300 and the annual expense of operations to be $2,800. Willis Chipman, C.E., is to make a report on the proposed plant.

Mrs. E. J. Sanford, Knoxville, Tennessee, daughter-in-law of Hon. W. E. Sanford, Hamilton, Ont., has given C. Mills, architect, Hamilton, instructions to prepare plans and specifications of a memorial cottage to be erected on the grounds of the Consumptive Sanitarium Association at Gravenhurst, Muskoka.

A license to manufacture in Canada has been granted to the Galena Oil Co., Toronto.

The new iron tank erected by the Edwardsburg, Ont., Starch Co., is nearing completion. It is to contain the water supply of the village, and is forty feet in height, and holds something like 90,000 gallons of water, standing on four legs which are strongly braced. These are sixty-five feet in height, a total height of 105 feet. Two filters are now being installed by the Caledonia Iron Works, Montreal.

The Department of Trade and Commerce has issued a circular calling the attention of manufacturers and others in Canada to the industrial and arts exhibition to be held at Grahamstown, South Africa, from 15th December this year to the 21st January next. Parties wishing to exhibit are asked to make application for space as early as possible, and are notified that arrangements will probably be made for the free transportation of goods to Cape Town. In all likelihood the Government will despatch a vessel direct from Canada to the Cape for the transportation of exhibits, if sufficient are forthcoming to guarantee a full cargo. Parliament, last session, voted an appropriation of $5,000, which can be devoted to this purpose.

Wray & Hawkshaw, Lucan, Ont., have decided to rebuild their flour mill recently destroyed by fire.

The Davis Dry Dock Co., Kingston, Ont., has supplied a compound engine to F. W. Fearman, Hamilton, Ont.

The contract for heating and ventilating the new St. Thomas schools has been given to the Pease Furnace Co., of Toronto.

The Pennsylvania Sanitation Co., Philadelphia, has offered to install a sewerage treatment system in London, Ont., which would treat one million gallons daily at a cost of $1,000 per annum. The bacteria method of purification would be employed.

Dr. Bryce, Toronto, secretary of the Ontario Board of Health, spoke to the town council on a system of sewage for Galt, Ont., recently. Dr. Bryce's address was of considerable length and he urged the people of Galt very strongly to establish a sewage farm at once.

A boiler in Chas. Betts' stave mill, Sycamore (near Coatsworth), Ont., exploded July 15th, instantly killing Jas. Pain, a mill hand, John Rambo, fireman, and fatally injuring Chas. Betts, owner of the mill. The Ontario Government has ordered an investigation to be held.

E. J. Rainboth, C. E., E. S. Leetham, R. G. Code, Ottawa; G. C. Rainboth, Aylmer, Ont.; A. J. Rainboth, Hull, Que., have been incorporated as the Ottawa Suburban Waterworks Company, Limited, to supply gas and water to the villages of Hintonborough and Ottawa East. The capital of the company is $10,000.

On July 12th the Bushnell Oil Co., Ltd., Sarnia, Ont., bought the Petrolia Oil Co., Ltd., Petrolia, Ont., for $4,000, and the Petrolia Crude Oil and Tanking Co., for $17,000, and on the 14th the same company bought the Petrolia Oil Co., Ltd., Sarnia, Ont., for $4,000, and the works of J. R. Minhinnick, London, Ont., for $4,000.

W. H. Croker has completed plans for a large addition to the Tudhope Carriage Company's Works, Orillia, Ont. It will be a four-story building, 50x120 feet. The new building will be used for a warehouse, and will have a floor space of 6,400 square feet, an addition 24x100 feet is also to be made to the woodworking department.

The following contracts have been entered into for the Charlottetown, P. E. I., sewage works: Vitrified pipe, Dodd & Rogers; hard stone, George Battye, Wallace, N. S.; grey stone, John F. Robertson; Portland cement, Dodd & Rogers; brick, Carvel Bros.; pumping engine, the Geo. F. Blake Mfg. Co.; boiler, etc., T. A. McLean.

The new steel bridge over the west branch of the Winnipeg river, Rat Portage, Ont., is now completed, except the approaches, which are to be of earth filling: The construction has been in the hands of T. Jevons, of the Peterborough Bridge Co. It is one of the largest highway bridges in Ontario, the main span being 222 feet in length.

The following tenders were received by the town of Listowell, Ont., for putting in waterworks plant: Clark & Connelly, Toronto, $13,647; McQuillan & Co., Montreal, $14,225; Hill & Gowanlock, $14,899; J. H. McNight, Toronto, $15,173; S. H. Craig, $16,800; J. M. Wallace (piping and trenching only), $6,795. Clark & Connelly were awarded the contract. The firm is installing a waterworks system in Mount Forest, Ont.

The 1898 catalogue of the Sun Bicycle Works shows that the proprietors, G. T. Pendrith & Co., 81 Adelaide street west, Toronto, are steadily gaining popularity with their wheels. "The Sun" wheel and the "Lakeside" are the two special makes of this firm. The latter for a cheap wheel is excellent value, and a Montreal purchaser of one of them informed the writer that her wheel, which cost $55, would pass for an $85 wheel anywhere.

At a special meeting of the Lachine Council, held July 13th, a by-law was adopted granting a bonus of $15,000 to Geo. Barrington & Sons, trunk manufacturers, Montreal, for which the firm will establish their factories in Lachine, Que. The conditions under which the bonus is granted include that the buildings and machinery to be erected to have a value of not less than $25,000, the erection of two factories, the permanent employment of 80 hands, the payment of $25,000 annually in salaries, proper insurance against fire, etc. The bonus will be paid when the factories are in full operation.

The rebuilding of the Truro, N. S., condensed milk and canning factory is progressing rapidly. The new buildings are to be roofed entirely with iron and the contract has been let to an Eastern firm. Roofs of this class are rather uncommon in Nova Scotia.

Incorporation has been applied for by the London Cold Storage and Warehousing Company, Limited, to build and operate a storage warehouse and ice factory in London, Ont. The incorporators are T. H. Smallman, John Labatt, M. D. Fraser, etc., all of London, Ont. The proposed capital is $75,000.

Railway Matters.

The G. T. R. will construct 250 refrigerator cars for the general service of the system.

A. H. Harris has resigned the position he occupied on the Intercolonial system of railways as traffic manager, and the office itself has been abolished.

Hawkesbury, Ont., has voted a bonus of $7,500 to the Canada Atlantic Railway, to build a siding to accommodate the proposed Riordon pulp mills in that town.

The C. P. R. has under consideration the construction of a branch line of the road to Brantford, Ont. Woodstock being the point at which the connection with the main line will be made.

Neil Keith, railway contractor, is building the C. P. R. branch from Killarney to Hartney, Manitoba. It is understood that Mr. Keith will also build a branch line from Reston to Moose Mountain.

The surveying of a route for the proposed railroad from Amherst, N. S., to the North Shore via Truemanville and Chapman settlement, has been decided upon by the Amherst and Eastern Railway Co.

The Master-in-Ordinary at Osgoode Hall, Toronto, has accepted the tender of Geo. M. Neelon, St. Catherines, Ont., for the purchase of the St. Catherines & Niagara Central Railroad. The bid was $35,000.

The Grand Trunk Railway is renewing the bridges between Island Pond and Montreal. The iron bridge over the Magog and the bridges at Massawippi, Lennoxville, Brompton and Richmond are among the number.

The G. T. R. celebrated the semi-centenary of its Portland line, July 4th. During this time the lines have been extended from 292 miles to 4,186 miles. Fifty years ago the passengers carried numbered 686,924, and in 1897 there were over 8,000,000.

O'Brien & McDonald, Renfrew, Ont., railway contractors, have a contract in Nova Scotia, to build a railway across Hants County between Windsor and Truro. The work which O'Brien & McDonald have consists of twenty miles of grading and sixty miles of ballasting and track laying.

The suggestion that railway employees should be subjected to a severe physical examination and course of technical instructions before being allowed to assist in the operating of trains and switch yards, has been made by the Association of Railway Surgeons in session at Toronto. The association elected as president for the ensuing year, Dr. Bruce L. Riordan, the G. T. R. surgeon at Toronto.

The contract between the city of Quebec and the Great Northern Railway Company has been signed by Mayor Parent and the Hon. P. Garneau, president of the railway company. By this agreement the city invests $200,000 in the stock of the Great Northern and the latter is to give Quebec railway connection with the Booth system, thus making Quebec an exporting port for the Parry Sound traffic.

H. D. Lumsden, C. E., of the Canadian Pacific Railway, who has been engaged at the head of several surveying parties, whose object was to secure a good route for the railway that company contemplates building from a point north of Toronto to Sudbury, Ont., states that a first-class line has been secured, and one where few engineering difficulties are met with. It is pretty well understood that the C. P. R. will enter upon the construction of the road without delay.

The Canadian Pacific will probably extend its Point Fortune branch of the Montreal and Ottawa to Hawkesbury, Ont.

A building 50 feet wide by 100 feet long will shortly be built on the G. T. R. car shops property, London, Ont. It will be for the stores department, and will cost about $5,000 or $6,000.

The Pullman Car Company has completed twenty first-class cars for the Grand Trunk, an order which represents over $100,000. The cars are all of the latest design, and will be a great addition to the Grand Trunk's rolling stock.

The Ontario Public Works Department has received information that the Pembroke Southern Railway, running from Pembroke to Golden Lake, on the Ottawa, Arnprior & Parry Sound Railway, a distance of about 20 miles, will soon be completed. The new line, which crosses the townships of Pembroke, Alice, and Wilberforce, and, after spanning the Bonnecheres river, connects with the O. A. and P. S. Railway, in the township of South Algoma, will, when completed, give Pembroke a competing line with the C. P. R., and will open up a very fair agricultural country. The railway is being constructed by Contractor Poulin, formerly chief engineer for the Parry Sound Colonization Railway.

W. D. Reid, son of R. G. Reid, the Newfoundland railway contractor, when in Montreal recently, stated that they had run a train through from St. John's to Port aux Basque, the terminus on the west coast, in twenty-four hours, the distance being 550 miles. The trial trip was made, however, under most favorable auspices, and the whole distance from east to west was run on schedule time. It is Mr. Reid's intention to establish hotels at different points on the system, so that when the expected influx of tourists, business people and sportsmen sets in, they may be comfortably provided for at whatever section of country they see fit to visit. At present Mr. Reid's steamer, the Bruce, makes two trips a week between Placentia and North Sydney, but with the railway to Port aux Basque the boat will run to that port three times a week, the distance across being made in six hours, and giving Newfoundland a tri-weekly mail to and from the Dominion of Canada. The establishing of separate steamship lines connecting the settlements along Placentia, Trinity and other bays, on south, east and west coasts, with his railway system, is also another important feature in Mr. Reid's vast enterprise in Newfoundland. Plans for seven of these steamers are now being prepared, six for the trade just mentioned, while the other is intended for the Labrador traffic. These vessels will be about 250 tons register, and besides being good freight carriers, will possess superior accommodation for about twenty first-class and from fifty to sixty second-class passengers. They are to be built on the other side of the Atlantic, and while some of them will be placed on their respective routes next spring, the remainder will commence the service a year later.

Marine News.

The steamer "D. L. Mather" was burned to the water's edge at Rat Portage, July 26th. It was insured for $8,000.

The Standard Oil Co. is negotiating with the Canadian Locomotive and Engine Works Co., Kingston, Ont., for the building of a number of steel tank barges to carry oil from the refineries to the distributing points.

The launch of the Dominion Atlantic Railway Company's steamer "Prince Arthur" took place at Hull, England, July 19th. W. R. Campbell, the general manager of the company, was present.

The Richelieu & Ontario Navigation Company will, it is understood, have another boat built at the Bertram yards as soon as the "Toronto" is launched. It will be called the "Kingston," and will be constructed on the same model as the "Toronto," and will cost $250,000.

Lieut. Porter, of the U. S. Cruiser "Yale," has been appointed to command the Rita when she is turned into a transport. He was the officer who commanded the prize crew when she was first captured. Mr. Porter is a son of the Rev. W. H. Porter, Brantford, Ont.

Petersen, Tait & Co. have been notified by the Canadian Government that the fast mail contract must be considered at an end. Petersen's firm will forfeit its deposit of £10,000.

An Ontario charter has been granted to W. J. Brown, Mrs. A. A. Brown, and John McLean, manufacturer, Detroit, U.S.; and T. Mulvey, and J. L. Galloway, Toronto, Ont., as the Georgian Bay Navigation Company, limited, with a capital of $20,000.

T. Eaton's steam yacht the "Wanda" was built from the designs by E. Redway, marine engineer for the Polson Iron Works, Toronto. The dimensions are: Length over all, 55 feet; beam, 3 feet 2 inches; draught, 3 feet 8 inches; displacement, 9 tons; triple expansion engines, 5½, 8½, and 14 inches, with 8 inch stroke; boiler, improved Yarrow carrying 200 lbs. pressure; indicated horse-power, 100; estimated speed, 16 miles per hour. The yacht cost $6,000.

Canadian Pacific Navigation Company are arranging for the building of a fast steamer for the route between Victoria and Vancouver, to give a daylight service. The plans are out, but at present the shipbuilding firms of England and Scotland have too much work on hand to undertake the contract, so it may be a considerable time before the work is begun. The new vessel will, it is said, be much larger than the "Charmer," and faster than any steamer now in service on the Pacific coast.

Last fall the United States government put surveyors on the route of the proposed Michigan-Erie canal, and the chief of the party has just made his report, and he says the canal would not be a difficult work to construct. The line would be from Benlow harbor on Lake Michigan to the Maumie River at Toledo. That would reduce the distance from Chicago to Toledo to 101 miles, a saving of over 900 miles over the present route from Chicago to the mouth of the Detroit River by way of Lake Michigan, Straits of Mackinac and Lakes Huron and St. Clair, and a canal to pass vessels of the heaviest tonnage of the lakes would cost about $40,000,000.

As soon as the proposed Montreal harbor improvements are commenced the Richelieu & Ontario Navigation Company's boats will have to take up new quarters. General Manager Gildersleeve has already made the necessary arrangements. The Quebec steamers are to lie where the "Laprairie" berths now, at the front slip below Jacques Cartier wharf, while the "Laprairie," "Cultivateur," "Three Rivers," "Terrebonne," "Berthier," and "Chambly" will rendezvous at the Victoria pier, or in adjacent slips. New sheds will have to be erected for freight.

Electric Flashes.

Street railway construction is being rushed in St. John's, Nfld., under Engineer Massey.

Galt, Ontario, will shortly vote on a by-law to provide for taking over the town's gas and electric lighing plant.

The Napanee Electric Light & Water Co. has ordered from the Royal Electric Co. a 35-k.w. two-phase generator and 500 light capacity in transformers.

The by-law to raise $19,500 for waterworks and electric light purposes in Listowell, Ont., was defeated, July 6th, by a majority of 71 votes, on a total vote of 427.

English capitalists have secured a controlling interest in the New Westminster and Burrard Inlet Telephone Company. The lines of this company extend over a considerable area.

The proposed Lanark-Perth electric railway is being revived. The subscribed capital is now said to be sufficient to build the road, and the company undertakes to complete it by April 1st next.

The town of Thorold, Ont., will receive tenders to Aug. 17th for an incandescent lighting plant of 1,500—2,000 lights, alternating current, according to specifications prepared by R. J. Parke, consulting engineer.

The desire for cheaper telephone service has induced the organization of a company in London, Ont., to rival the Bell Co., and give a house service at $18 and office for $25. Several strong local capitalists are interested, including Col. Leys, John Labatt and John Milne, The Electric Street Railway, Cornwall, Ont., is building a deep water wharf at St. Lawrence Park.

The Jenckes Machine Co., Sherbrooke, Que., has the contract for installing the lighting plant at Granby, Que.

David Spiers, Galt, Ont., has bought a water power, and may install a power plant if satisfactory arrangements can be made.

The Ottawa Electric Railway is putting its employees on a ten-hour day instead of the eleven hours which had caused some friction.

The West Kootenay Power and Light Co. is now delivering 1,000 h.p. in Rossland, B. C., from its generators at Bonnington Falls, B. C., 30 miles away.

Mrs. Wm. S. Dockrill, Montreal, has ceased to do business alone under the name of W. S. Dockrill & Co., and has formed a partnership under the same name, as electrical engineers with Ernest W. Sayer.

McCurdy & Co., of Antigonish, N. S., are enlarging their electrical plant and have a contract to light the streets of the town. A 60-h.p. engine and boiler have been ordered from the Robb Engineering Co., Amherst, N. S.

McCurdy & Co., Antigonish, N. S., are enlarging their electric light plant and have a contract to light the streets of the town. A 60-h.p. engine and boiler has been ordered from the Robb Engineering Company, Amherst, N. S.

At a meeting of the special committee of the Hamilton city council, on civic electric lighting, it was decided to recommend the council to engage Roderick J. Parke, Montreal, consulting electrical engineer, to report on the cost of establishing and operating a civic electric light plant. The council, however, overruled the committee and engaged Percy Domville.

The Niagara Falls Park & River Railway Co., are now running cars every five minutes over the upper steel arch bridge. The first car was run over, July 1st, with Supt. Rothery at the motor. Manager Phillips of the N. F. P. & R. R., and Supt. Dill, of the new bridge, were on board.

The Crow's Nest Pass Coal Company, ltd., Fernie, B. C., has placed an order with the Royal Electric Co. for 2 25-k.w. direct current generators wound for 250 volts, from which is to be operated a trolley-car equipment for drawing coke to the smelters and also mining, hoisting and lighting apparatus.

The London, Ont., Electric Co. is now installing two 160-k.w. direct current power generators, and a 300 k.w. alternator of the revolving field type, from the Canadian General Electric Co. The power generators will be operated by two engines of 250-h.p. each, made by E. Leonard & Sons, of London.

Edward Slade, electrical contractor, Quebec, is putting in a dynamo, and the necessary wiring for the electric lighting of Capt. Bolduc's new steel boat the "Orleans," plying between Quebec and Ste. Petronille. Mr. Slade has got the contract for wiring the SS. "Champion," and also the Beaufort Asylum, 600 lights.

C. E. Shedrick, who manufactures in Canada the apparatus of the Whitney Electrical Co., will again occupy a portion of the Sherbrooke, Que., Gas & Water Co.'s building recently destroyed by fire as soon as it is ready for him. The business, which has been rapidly increasing in volume, will not be injured by the fire to any great extent.

R. A. Bayley, sec.-treas. of the People's Telephone Co., of London, Ont., has written to the Mayor of Hamilton, Ont., requesting that that city do not grant a franchise to any parties for a telephone company without communicating with it. This is in connection with the movement to establish local telephone companies in each town in Ontario in opposition to the Bell monopoly.

H. Alabaster, Gatehouse & Co., publishers, 4 Ludgate Hill, London, E. C., announce that the 1899 edition of the "Universal Electrical Directory" is in course of preparation for its 18th annual issue in January next. Manufacturers and others interested would do well to send in their names at once so as to be included in the forthcoming edition. No charge for such insertion is made.

Some Galt, Ont., people have formed a scheme for the construction of an electric road from New Hamburg to Galt through Haysville, New Dundee, Roseville and Blair.

Paris, Ont., wants to secure C. P. R. connection by building an electric line from Paris to Ayr, Ont. The promoters are asking for no bonus, but simply for the right of way through the municipalities, a distance of seven miles.

A scheme is on foot to connect Brantford, Ont., and Port Dover electrically, a new line being built from Port Dover to Waterford, and the T. H. & B. tracks being used from there to Brantford. The proposed line is to be known as the Brantford & Port Dover Railway.

The poles for the Cataract Power Co. are now all up between Hamilton and Decew's Falls. Four heavy copper wires are strung from Hamilton to Stoney Creek, about one-quarter of the total distance, and the balance will be strung at the rate of two miles a day. The insulators are being tested at an average of 600 per day, and are tested up to 70,000 volts.

Ontario charters of incorporation have been granted to the following companies: "The People's Telephone Company, of St. Thomas, ltd.," with a capital of $60,000, and the following projectors, A. E. Wallaee, E. A. Smith, F. M. Griffin, S. Chant, W. H. Murch, D. McLarty, T. W. Duncome, J. Campbell and A. McCrimmon, of St. Thomas, and H. C. Walters and R. H. Evans, of Detroit, and also to the "Electric Cloth Cutter Company of Toronto, ltd.," with a capital stock of $40,000.

Notices are being sent out to the creditors of the Hamilton Electric Light & Power Company, asking them to send in their accounts for settlement, in view of the taking over of the company's business by the Cataract Power Company. This is understood to refer to a bargain by which the Cataract Power Company undertakes to supply power for fifteen years, and will share in the expected increased profits, but the Hamilton Electric Light & Power Company will not be absorbed, but will continue in existence. It is said the bargain also permits the Cataract Power Company to supply power to the city if the latter goes into the electric lighting business.

The Canadian General Electric Company is manufacturing an incandescent lamp called a "night lamp." It has a device by which it can be changed from 16 c.p. to 1 c.p. The transformation from 16 to 1, or from 1 to 16 c.p., is effected by turning a small screw on the side of the lamp. The current consumed by the lamp when burning at one candle power is less than half of that which it requires at 16 candle power. In appearance, the night lamp resembles the ordinary 16 candle lamp with its bulb frosted. The peculiar construction of this lamp which gives it its double nature, consists in dividing the carbon filament into two sections, one of which is switched into circuit when 16 candles are desired, and both sections—one in line with the other—when only one candle is desired. The additional resistance causes the filament to give out less light.

Henry Symons, Q.C., has just returned from England, where he had estimates prepared for the construction of the proposed works of the Welland Power & Supply Canal Company. This project involves the construction of a canal from the Welland River to the brow of the Mountain at Thorold, a distance of 8 miles; the construction at Thorold of a power house, and from Thorold to Lake Ontario, a raceway by which to carry water into the lake. In addition to these different works, estimates were obtained for the construction of a transmission line from Thorold to Toronto by way of Burlington Beach. The estimates obtained by Mr. Symons were prepared by Dr. Hopkinson, F.R.S., one of the leading electricians of Great Britain; Sir Douglas Fox, Edmund Wragge, late of Toronto, and W. C. Unwin. The estimate for the machinery to generate 100,000 horse-power is £125,000; for transmission line to Toronto at a voltage of 10,000 and delivery of 50,000 horse-power, £801,600; for excavation and other work connected with the undertaking, £1,525,062. The total estimate therefore amounts to £2,452,162, or roughly speaking, $12,000,000. If the amount to be delivered in Toronto is reduced to 20,000 horse-power, the project would cost $1,000,000 less. S. Pearson & Son, contractors, state that if the contract could be secured from the cities of Toronto and Hamilton for a considerable quantity of power, for a definite term, there would be little difficulty in raising money for the project by bonds and shares in Great Britain.

Mining Matters.

Mica of very fine quality has been discovered near Arkell, Ont.

A steam plant is being installed on the Atlantic Cable mine, Rossland, B.C., owned by William Caldwell, Toronto.

Rich quartz is reported from the township of Dysart, Haliburton, Ont. It is also stated that beds of sand containing gold exist in the same locality.

Efforts are being made to develop natural gas extensively at Humberstone, Ont., with a view of inducing manufacturers to locate in that neighborhood.

The Summer Mining School maintained at Rat Portage, Ont., by the Ontario Government is conducted this year by J. Watson Bain, B.A., Sc., of the School of Practical Science, Toronto.

The War Eagle mine of Rossland has let a contract to the Wellman & Sevver Co., Cleveland, Ohio, for the construction of a large steel gallows, frame and hoisting apparatus, at a cost of $20,000.

The Donnelly Bros., Kingston, Ont., have purchased all the plant of the Frontenac Oil Company at Fredericksburg. The plant consists of steam engine and boiler, 15,000 feet of 8-inch pipe, drill, derrick and tools.

The Kaladar and Anglesea Gold Mining Company will at once begin the erection of a separating plant on its property at Bridgewater, Ont. The work will be performed under the direction of Dr. Eames, the company's assayist.

A company has been formed in Vancouver, Ont., to dredge for gold in the rivers of the Yukon district. A special pneumatic caisson and air-lock elevator will be used, which it is claimed will make the work of dredging to bed rock easy. H. Abbot, R. G. Tatlow, J. W. Campion, S. O. Richards and Major C. C. Bennet, Vancouver, are interested in the company.

The Harris Sulphur and Copper Company, Glasgow, Scotland, has secured options on several copper mines in Newfoundland, which were secured by an expert sent out to examine them. These properties include the Colchester, Robert's Arm and Sunday Cove mines, all situated on North Dame Bay, as well as a lease of the Silver Cliff mine on Placentia Bay.

R. Prefontaine, M.P., J. R. Fair, Montreal; C. A. Chenevert, Berthierville; A. Brosnan, J. U. Gregory, Quebec; C. King, Sherbrooke; L. F. Morrison, Saint Hyacinthe; C. Nelson, Montreal, and W. de F. Nelson, Saint Paul, U.S.A., have secured a Quebec charter as the Eastern Townships Chrome Iron, Mining and Milling Company, Ltd. Capital, $50,000; headquarters, Montreal.

Archibald Blue, Director of the Bureau of Mines, has received a letter from Prof. W. L. Goodwin, Principal of the Kingston School of Mines, stating that the summer mining at Parry Sound had proven a great success. In all 51 students had attended, and the daily average attendance had been 20. The school at Mattawa had been, he said, even more successful. There 72 students had come, and the average attendance had been 45, and there was no indication of a falling off. The bureau has divided their summer school between the School of Science and the Kingston school, the former taking the district west of Michipicoten and the latter Michipicoten and the territory east.

The officers of the Toronto Smelting Company, Limited, Madoc, Ont., are: James Kendry, M.P., Peterboro, president; J. B. Hay, Toronto, 1st vice-president; F. C. Flannery, Toronto, sec.-treas., and W. A. Hungerford, M.E., Belleville, general manager. Two smelters of five and fifteen tons capacity respectively have been put in for the smelting of ore and the manufacture of mineral wool. Mr. Burton of St. Louis, Mo., has charge of the smelters; Mr. Norman, a gold medalist graduate of the school of mines for the State of Missouri, is in charge of the assay department, and George Lee, of Staffordshire, England, superintends the roasting of arsenical ores.

As showing the extent of the work going on in Rossland at present a western contemporary states, when speaking of the recent driving of a tunnel between the Le Roi and the Black Bear mines: "Only a very few feet of work would be necessary to drive a shaft from the Le Roi's workings to those of the Centre Star, and if this is ever done it would give a continuous underground passage from the Black Bear through the Le Roi into the Centre Star, thence into the Iron Mask and from there to the War Eagle, for the workings of the latter mines are already connected. From the War Eagle it would require only a few feet of work to connect with the Poorman, and as the latter already opens into the Josie, it would thus extend the chain of connecting properties through to the latter mine. The horizontal workings thus connected would measure about three miles in length."

The Cumberland Railway and Coal Co. has a contract for 50,000 tons of coal for the I.C.R.

The Grand Calumet Mining Co., Calumet, Que., has made a trial shipment of 250 tons of ore to Belgium.

J. E. Hardman, B.Sc., of Montreal, spent some time in the Whycocomagh district of Cape Breton recently, in the interest of Canadian capitalists.

Wallace Bell, well sinker, St. Lawrence street, Montreal, has gone to Newfoundland, where he will help in developing the newly discovered oil regions in the island.

F. H. Drew, Michipicoten, Ont., reports the discovery near Lake Wawa of a vein of copper-bearing ore very much like that in the famous Calumet and Hecla mine, Michigan.

Gold is reported from Chelsea, Molega, Lunenburg county, N.S., and prospectors are said to have cut a large and rich looking lead there, which shows gold very plainly in the outcrop.

The Boston Company developing the oil wells of Lake Ainslie, Cape Breton, are progressing favorably with the work. They have lately received 16,000 feet of wall casing which will be utilized in the work.

W. J. Hopgood, Spring Garden Road, Halifax, N.S., has chartered a small schooner which will carry provisions, implements and mining men necessary to prospect for some time on the coast of Labrador, where traces of gold have been reported.

The Ingersoll-Sergeant Drill Co., New York, has just issued a new air compressor catalogue, No. 32, which illustrates and describes the compressors which are making such a name for themselves on the Canadian market, for which they are manufactured by the Jas. Cooper Mfg. Co., Ltd., Montreal.

The old Bruce Mines, near Thessalon, have been taken over by Lord Douglas, of Hawick, on an option, writes an associate of this gentleman, to the Bureau of Mines. For some time past Lord Douglas has had experts at work on the mine, and their reports have been very encouraging.

E. R. Faribault, of the Geological Survey, Ottawa, is at present at work in Nova Scotia. He will survey Renfrew, South Uniacke, and Mount Uniacke. After these districts are covered, he will remove to Halifax and from there go over Cow Bay, Montague, Lake Catcha and possibly Lawrencetown and Tangier.

A deposit of manganese has been located at New Ross, Lunenburg Co., by Charles Keddy and W. Rafuse, on the property of Peter Benjamin of the above place. It is said that several barrels of the outcrop were sent to New York to be tested, and the reports received are said to give ore values of from $15 to $60 per ton.

The Government has refused to prohibit the exportation of natural gas from Ontario, as requested a few weeks ago by the largest deputation that ever visited Ottawa. The people of Essex asked, failing total prohibition, for a heavy export duty. This, too, has been refused. Permission has been given the American concern—the Interior Construction and Improvement Company—to lay two new conduits from the town of Sandwich to Detroit, and to convey across the border up to three billion feet of gas per annum. This is accompanied by some conditions which may not be enforcible. At the end of three years the company which is now reaching out into Ohio, is to confine its operations to Detroit. It is provided that natural gas must at all times be sold in Canada at ten per cent. lower than the lowest price at which it is sold at any other point, and that the selling price in Canada at any well, or on the highway nearest the well, shall not exceed five cents per thousand feet. The company is forbidden to use artificial means for drawing gas from the wells.

From Sault Ste. Marie Prof. A. P. Coleman, of the Provincial Crown Lands Department, writes his chief, Director Blue, of the Bureau of Mines, as follows: "We have just returned from a ten days' trip down the St. Mary's River, and along the north shore of Lake Huron as far as Thessalon. We visited Garden River, Echo Lake, Bruce Mines and Thessalon, making a survey of the shores and pushing a few miles inland at each place. The more important mines along the shore and inland have been visited, with the exception of the placers near Thessalon, where we found no work is at present going on. We hope to see them later in the summer. The most interesting point was, of course, Bruce Mines. We found the Cleveland Company at work with more than forty men at the quarry of 'trap' or diabase, for the boulevards of that city. Mr. Spence, who is managing the operations at the quarry, says that these roads cost at present $2 per square yard, and that the surface, when complete, is far better than asphalt, not having the slippery character of the latter in rainy weather, and being far more durable. This pavement might be introduced into Toronto for good residence streets."

Considerable interest has been aroused in England over the discovery of corundum in the township of Carlow, Hastings county. Ontario corundum, it will be remembered, is a valuable substitute in the manufacture of abrasive wheels, and is also one of the chief bases of aluminium. In an editorial the London (Eng.) Mining Journal discusses at length the discovery of the mineral in Hastings and speaks about its possibilities as a commercial product. The Journal notes the fact that the deposits have been traced through over seven different townships over an area of about 100 square miles, and goes on to give in detail the circumstances surrounding the discovery of the deposits and its exploration by private parties and agents of the Ontario Government. The Journal then proceeds to say that in the United States and in Europe aluminium is produced chiefly from kaolin and cryolite, which contain a smaller percentage of the finished metal than does corundum. The only known valuable cryolite mine is in Greenland, where mining operations are conducted with much difficulty. In Ontario these corundum deposits are easy of access and may be worked continuously all the year round. As an abrasive material this corundum has already been favorably reported upon by American experts who have examined samples. If it turns out, as seems probable, that the corundum can be smelted economically for the production of aluminium this will give it a value second to none in the mineral resources in Ontario. The tests which have so far been made are merely sufficient to show that successful concentration of the ore is feasible on a large scale. The Mining Journal gives prominence to its editorial and seems to consider the possibilities of the Hastings deposits to be good.

Personal.

T. J. Sabin, contractor, Peterboro, Ont., was drowned in Little Lake, Ont., while fishing.

R. Cullen, snperintendent of the sulphite plant in the Riordon Paper Mills, Merritton, Ont., has gone to Hawkesbury, Ont, to superintend the mills to be established there.

Grant Hall, mechanical foreman of the Intercolonial Railway, Moncton, N.B., received notice of dismissal, to take effect on Aug. 31. His place is to be taken by Fred G. Hunter.

Edward Butler, Government electrician for the Lachine Canal, Montreal, died recently after a three weeks' illness. He was forty-two years old, and leaves a widow and eight children to mourn his death.

Mr. Spencer, formerly an engineer in the employ of the Peninsular and Oriental Steamship Co., running between Bombay and Hong Kong, has located in Galt, and is now employed by the Goldie-McCulloch Co.

James Green, a well-known G.T.R. engineer, died at Stratford July 13th, aged forty-four years. About twenty-three years ago he entered the employ of the G.T.R., and had ever been a faithful and attentive employee.

John Patton, foreman pattern maker in the Truro Foundry and Machine Co.'s works, and one of the oldest employees of the company, lost four fingers from his right hand, owing to it coming in contact with a saw a short time ago.

Andrew Harrison, an employee of the Canada Sugar Refinery &o., Montreal, was killed a short time ago by coming in contact with the transmission wires of the Lachine Rapids Hydraulic and Land Co. while holding on to part of an iron bridge.

Henry Szlapka, engineer and manager of the Hamilton Bridge Works Co., Ltd., Hamilton, Ont., was very successful in the discharge of his duties when on the staff of the New Jersey Steel and Iron Co., Trenton, N.J., where he had charge of the designing department.

Joseph Taylor, formerly secretary of the Michigan Peninsula Car Works, and identified for years with some of the most prominent business interests of Detroit, died July 19th at his summer residence, Taylor Point, Sandwich, Ont. Mr. Taylor was 58 years of age, and was born in England, but had spent the greater part of his life in Detroit. He was formerly for ten years chief assistant to the general manager of the Great Western Railroad.

T. B. Speight, of Speight & Van Nostrand, has been commissioned by the Government to run an exploration line due north from the head waters of Goulais River, following the 84th meridian, to the C.P.R. Railway, a distance of 90 miles. This is a district that is almost wholly unknown. Mr. Speight will be accompanied by a woodranger and a geologist, W. A. Charlton, who will explore the country for a distance of ten miles on either side of the line, and report upon the timber and mineral resources and the agricultural possibilities of the district.

Joseph Middlemas, engineer at the Deaf and Dumb Institute, Belleville, Ont., has been relieved of his duties.

Jos. McGregor, Nanaimo, B.C., has been appointed provincial inspector of metallurgical mines for British Columbia.

George Todd died in Fredericton, N.B., on the 12th ult., at the age of 86 years. He was the originator and manager of Todd's foundry, Woodstock, N.B.

J. N. Young, general manager of the Dominion Construction Company, has removed from Hamilton to Chicago, after a residence in the former city of about nine years.

Leopold Meyer, mining engineer, of California, has moved to Ottawa, Ont, with his family, to live. He has been appointed manager of the Grand Calumet mine, Pontiac county, Que.

Thos. McFarlane, lately chief clerk in the office of the superintendent of motive power of the Grand Trunk Railway, Montreal, died in Brockville, Ont., a short time ago, at his father's home.

Wm. Tye, C.E., formerly of Haysville, Ont., has been appointed chief engineer of the Robson and Boundary Creek Railway at $5,000 a year, and a good bonus if he succeeds in getting it finished on time.

D. McLennan, of the Auditor-General's office, has been appointed astronomical computer to W. F. King, chief astronomer of the Department of the Interior. Mr. McLennan is a graduate of Toronto University.

W. J. Weller has been appointed superintendent of bridges and buildings of the Crow's Nest Pass branch of the Canadian Pacific Railway, with headquarters at Lethbridge, Alberta, in place of R. Balfour, resigned.

W. F. Robertson, New York, who has succeeded W. A. Carlyle as British Columbia minerologist, is a graduate of McGill University, and is very highly recommended by Dr. Dawson, head of the Dominion Geological Survey.

Henry Tandy, of Dunkirk, N.Y., has been appointed superintendent of the Canadian Locomotive and Engine Company, Kingston, Ont., in place of F. J. Leigh. Mr. Tandy was previously connected with the works in Kingston, and is a capable manager.

Thomas A. Harvey, formerly with Moore & Henry, London, Ont., who has recently graduated with the degree of civil engineer from the Rennsselaer Polytechnic Institute, Troy, N.Y., has taken a position in the bridge and construction department of the Pennsylvania Steel Company, Harrisburg, Pa.

J. Murphy, engineer for the Cornwall Electric Street Railway, who has taken a good position in Montreal, was presented by the employees of the railway with a beautiful smoking set as a token of their esteem. The present was accompanied by an appropriate address, which was read by Mr. Taylor, superintendent of the company.

Among the Royal Military College graduates who have recently received good appointments are: Capt. A. H. Van Straubenzie, R.E., who has been appointed to the command of the "M" submarine mining company at Chatham. He is a son of Lieut.-Colonel Van Straubenzie, late D.O C., Kingston. Lieut. A. Adams, R.E., third-class, first grade superior revenue establishment of Burmah State railways traffic department, has been promoted to second class fourth grade of that establishment. He is a son of Mr. Adams, architect, late of the Kingston penitentiary staff. Captain A. C. Joly de Lotbiniere, C.E., has been appointed assistant instructor, School of Military Engineering, Chatham.

We regret to record the death, in Montreal last month, of Thomas Hartnell Spurrier. Mr. Spurrier was born in Shepherd's Bush, London, England, thirty-seven years ago, and was educated at Spurgeon's College and afterwards at Regent's Park College. His parents intended him for the ministry, but Mr. Spurrier preferred literary and artistic work, and was engaged in painting and newspaper work before coming to Canada. He settled in Montreal five years ago and was engaged by McGill Medical College to do the anatomical painting of that institution. He also contributed some spirited cartoons and sketches for the daily press as well as for THE CANADIAN ENGINEER. He was very popular among the engineers, his sketches of the annual conventions having been much appreciated. A few weeks before his death he had finished the compilation of a book on the "Yukon Region of Canada," which is shortly to be published by a London House. Mr. Spurrier was an agreeable companion and conscientious worker and will be mourned by many friends as well as his family. He leaves a wife and three young children. He had just brought his two eldest children through a severe attack of typhoid fever, which he himself took with fatal result as they were recovering.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during June and the six months ending June, 1897, 1898:—

	Month of June.		Six months ending June.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£6,283	£1,675	£31,930	£11,918
Pig iron	1,847	384	2,865	6,157
Bar, etc.	808	1,627	5,013	6,737
Railroad	..	7,845	20,286	14,817
Hoops, sheets, etc	6,245	5,034	22,690	16,626
Galvanized sheets	3,377	3,187	19,375	24,167
Tin plates	7,981	11,507	88 953	73,475
Cast, wrought, etc., iron	2,369	2,684	17,334	16,342
Old (for re-manufacture)	925	1,571	1,497	3,075
Steel	4,958	3,559	23,438	27,857
Lead	2,806	4,240	7,260	12,290
Tin, unwrought	909	1,698	9,834	10,785
Alkali	3,638	4,273	15,360	21,010
Cement	1,777	1,700	6,555	10,052

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

I think it advisable, in an article of this kind, to state, as premises, certain propositions which might be treated as deductions. Some of them are self-evident, and ought to appeal to any practical mind as being truths, rather illustrated than demonstrated by the experience of the past few years. In accordance with this line of treatment, I desire to state by way of premise:

It may be claimed that no construction is "fire-proof," and that even iron and masonry could with propriety be designated as "slow burning." The iron or steel used in a modern building has, in its time, been smelted in a furnace which presented no greater capacity for running metal into pigs than some of our modern buildings, whose interior openings from cellar to roof correspond to the chimney of a furnace, and the front door to its tuyere. If a pyrometer could be adjusted during the progress of a fire it would be found to rise quite as high as in any forge.

Glass windows will not prevent the entrance of flame or heat from a fire in an exposed building. It may seem strange that so obvious a proposition should be thought worth stating, and yet to-day more than 75 per cent. of the "fire-proof" structures of the country have window openings to the extent of from 30 per cent. to 70 per cent. of the superficial area of each enclosing wall without "fire-proof" shutters. Heat from a building across a wide street finds ready entrance through windows, and the several "fire-proof" floors serve only to hold ignitible merchandise in the most favorable form of distribution for ignition and combustion, like a great gridiron, to the full force of a neighboring fire. A recent article on the Pittsburgh fire in The Engineering News aptly expresses this in the following words: "There seems to be some irony in calling buildings 'fire-proof' which opposed hardly anything to a fire from across the street more sturdy than plate glass!"

Openings through floors for stairways or elevators, gas, water, steam pipes, and electric wires, from floor to floor of "fire-proof" buildings tend to the spread of flame like so many flues and should be fire-stopped at each story. This fault is more generally overlooked than any other. Ducts for piping, wiring, etc., should never be of wood.

In view of the fact that it is necessary to cover iron with non-combustible, non-conducting material to prevent its exposure to fire and consequent expansion, and in view of the fact that all ironwork, except cast iron, will rust to the point of danger, it is best to use cast iron for all vertical supports, columns, pillars, etc. It is not advisable, of course, to have floor beams of cast iron (except in the form of Hodgkinson beams thoroughly tested). If a floor beam should give way, however, it might not necessarily wreck the building, whereas if a vital column should give way a collapse of the entire structure might result.

At a convention held some years ago in New York, at which were present a greater number of experts in iron than probably ever met before or since in one room, there was not one who contended that cast iron would rust beyond the harmless incrustation of the thickness of a knife blade, whereas there was not one who did not believe wrought iron would rust to the point of danger; and there was not one who claimed to know whether steel would or not, each admitting that steel had not been sufficiently tested as to rust to warrant a reliable opinion. If it could be relied upon as rust-proof, it would be superior to all other material for "fire-proof" buildings because of its great strength in proportion to weight. The use of steel in construction is growing, because it is cheaper than wrought iron, as lighter weights are used for the same strength, but while supposed to be superior to wrought iron, some of the prevailing impressions with regard to it are erroneous. Defects not possible of detection by tests are liable to exist in its structure. Among the first steel beams brought to the city of New York there were instances in which they were actually broken in two by falling from the level of trucks to the pavement, probably due to their having been rolled when too cold, as steel when rolled below a certain temperature becomes brittle. Better beams are now made. In my opinion, cast iron columns are superior to steel and more reliable. It is not generally known that American cast iron is vastly superior to English cast iron, and will stand a greater strain without breaking. Cast iron, moreover, will not expand under heat to the same extent as wrought iron and steel, which is another fact in its favor.

No bearing column should be placed in such a position that it cannot be uncovered and exposed for examination without danger to the structure. One of the ablest architects in New York makes it a rule to so "fire-proof" his columns that they can be examined at any time by removing the "fire-proofing" to determine whether rust has invaded their capacity to carry their loads. In my judgment, examinations should be made, from time to time, in this way, of all wrought-iron or steel columns, as it may happen that a leaky steam or water pipe has worked serious harm. Such a discovery was accidentally made recently in an important New York building. Numerous newspaper paragraphs appear, from time to time, which claim that metal stripped of its covering of cement has been found exempt from rust, with the paint intact, etc., and the fact is cited as evidence that cement is a preservative of iron and that the danger of rust is over-estimated. It is probable that cement will protect paint for a long time, and, of course, paint, if properly put on, will protect iron while the oil in it lasts. Painting, by the way, should be done with the best quality of linseed oil and without the use of turpentine, benzine, or dryers. It should be thoroughly applied in three coats, with about a gallon to 400 square feet, and the iron should be first thoroughly cleaned of rust and dirt, by picking or other process. Paint is rarely properly applied, however, and even when of the best quality, is a preservative of the metal, as already stated, only so long as the oil in it lasts.

Those who claim to have evidence of the exemption of iron from rust rely, I think it will be found, upon iron which has been under exceptionally favorable conditions, free from dampness, the action of gases, etc., overlooking the fact that a leaking water pipe or steam pipe, or the escape of gases from boiler furnaces will attack iron and gradually but surely consume it. A notable instance of this is the case of the plate girder of the Washington bridge over the Boston and Albany Railroad in Boston, where a quarter-inch plate girder was recently found to be entirely consumed in places from the operation of gases from the locomotives passing below.

It is quite common to have advocates of wrought iron cite railroad bridges and the elevated railroad structures of New York as proof of their claims, but if they will take the trouble to examine these structures, they will discover that in spite of the fact that they are exposed to view, that they can be painted frequently, the evidences of rust are unmistakable, especially about the rivets; and one can well imagine what would be the result in the case of riveted iron members in the skeleton structure of a building where such ironwork is entirely concealed from view, periodical inspections being impossible. Rust is especially liable to be found in the cellars and basements of buildings. The wrought-iron friction brakes of freight elevators in the cellars of stores, for example, are frequently found so consumed with rust as to be easily rubbed to pieces in the hand. Steel rivets are dangerous and they should never be used, unless of a very superior quality, so soft that hammering will not crystallize the material, and yet with sufficient tensile strength

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*Extracted from the publications of the British Fire Prevention Committee.

to insure perfect holding qualities. This is difficult to secure. Their use in columns for buildings is objectionable, as they rust badly under certain conditions; columns, therefore, should be without rivets, and the beam-bearing bracket shelf on cast iron columns should be cast in one piece with the column. It is generally supposed, and frequently stated, that there is a great difference between the expansion of iron and masonry by heat. This is not the case. For example, the length of a bar which at 32 degs. is represented by 1, at 212 degs. would be represented as follows:

Cast-iron	1.0011
Wrought iron	1.0012
Cement	1.0014
Granite	1.0007
Marble	1.0011
Sandstone	1.0017
Brick	1.0005½
Fire-brick	1.0005

In the "fire-proof" building of the Western Union Telegraph Company, in New York, some years ago, a heavy brick pier, 7 or 8 feet in diameter, adjoined the wall of the boiler furnaces. The difference in expansion in the brickwork next to this furnace wall as compared with that of the remaining brickwork of the pier was so great as to produce a crushing of the material from top to bottom of the pier for a depth of several inches, and it was found necessary to change the furnace wall and leave an air space between it and the pier.

While the difference in expansion between masonry and iron incorporated with it is less per running foot than is generally supposed, and while the difference in expansion between a cubic foot of iron and that of a cubic foot of masonry would hardly be noticeable, especially if the iron were covered on all four sides, yet in stretches of 50 feet or more, as in the case of iron I-beams and girders, the cumulative effect of expansion in uncovered iron might be a serious matter—quite sufficient with the rises of temperature due to a burning building to push out the bearing walls and wreck the building. Especially is this true of temperatures higher than 500 degs. It is unnecessary to suggest that metal differs from masonry in the important respect that heat does not travel throughout the entire length of the latter, while it does in the case of metal. In other words, while the difference between the expansion of a lineal foot of iron as compared with a lineal foot of masonry, marble, brick, etc., is very slight, the difference in conductivity is very great. The conducting power of silver, for example, being represented by 1, copper would be .845, cast iron .359, gold .981, marble .024, and brick .01—an important fact to be considered in the construction of buildings. Brickwork raised to a white heat would not raise the temperature of other masonry in the same wall a few feet away, but one end of an iron I-beam could not be raised to a white heat without raising the temperature of the beam for its entire length.

Where iron beams and girders are inserted in walls without sufficient space left for their expansion under heat they are almost certain to overthrow the bearing walls by their expansion thrust. A large warehouse in Vienna in which such provision had been contemplated by the architect was totally destroyed, with its contents, by reason of the fact that an officious subordinate, discovering the space in the wall purposely left at the end of each beam, deliberately poured liquid cement therein, which, having set, effectually thwarted the well-meant intention of the architect, and resulted in the destruction of the building. The expansion thrust of iron beams may be computed upon the following factor of expansion: Rolled iron of a length of 1,562 feet will expand one-eighth of an inch for every degree of temperature. The heat of a burning building as already stated is enormous—sufficient to fuse most known materials; it may safely be estimated to be at least 1,000 degs.; therefore a length of rolled iron of 1,562 feet at 1,000 degs. of temperature would expand about 125 inches and a 50 foot length of iron girder would expand between 4 and 5 inches, showing that there should be a play at each end of at least 2 inches if the iron is not fire-proofed. Inasmuch as in iron construction the iron beams and girders are usually anchored to the walls to steady them, space should be left and the tie to the anchor should be by a movable hinge joint, which would be of the same strength with an inflexible anchor for all tying purposes, but would yield under the thrust pressure like an elbow and allow play of the beam, or stiff anchors should have elongated holes to allow expansion when beams are of great length. Girders are seldom over 25 feet long, but if bolted together, as is frequently the case, they may be 120 feet or more long, and a line of columns from cellar to roof of a building may easily have one continuous iron structure of two hundred or more feet. It should be remembered, however, that this danger from the expansion of iron may be almost wholly counteracted by protecting it from exposure to fire through the use of non-conducting material. It is more important to protect girders than beams.

The mistaken pride with which the owners of some buildings point to exposed iron beams in ceilings as evidence that the floors are "fire-proof," actually justifying the supposition that they are left exposed for such display, would be ludicrous if it were not serious. In buildings occupied for offices or dwellings, where there is not sufficient combustible material to endanger the beams, it is not so objectionable; but in warehouses and stores, filled with merchandise, such construction is dangerous; and if one of the upper floors should give way it would come hammering down to carry all below and thoroughly wreck the structure. In this connection it is well to say that combustible merchandise should never be stored 100 feet above the street grade even in a "fire-proof" building, since the average fire department cannot reach it at that height.

The roof, that portion of a building which ought to be most carefully watched during construction, is often the most neglected, woodwork entering into the composition, as in the case of the Horne building, at Pittsburgh, where the cornice was supported on wooden outriggers.

Partitions.—These should not be erected upon wooden sills, as is sometimes the case—only, however, with ignorant and inexperienced architects, who suppose that it is necessary to use wood in order to nail baseboards and other trim at the bottom of the partition. Porous terra-cotta will hold nails and should be used in preference to wood, which, as soon as it burns out, will let down the entire partition.

(To be continued).

—At a meeting of the Board of Governors of McGill University, held July 28, Ernest Rutherford, M.A., B.Sc., Trinity College, Cambridge, was appointed W. C. McDonald Professor of Physics, and Dr. James Wallace Walker, of University College, London, was appointed W. C. McDonald Professor of Organic Chemistry. Both the new professors have had most successful careers hitherto, and we hope they will add to their laurels while at McGill.

JAMES MILNE, Mem. Can. Soc. Civ. Eng. Late Gen. Supt. Toronto Incandescent Light Co. Teacher Elec. Eng'n'g Steam and Steam Engine, Toronto Technical School.

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CANADIAN TRADE WITH SOUTH AFRICA.

A steamship has been chartered to convey Canadian exhibits to the Exhibition to be held shortly in the city of Graham's Town, Cape Colony. She will remain at Quebec till the end of the month to load exhibits. We understand that further information may be obtained from the Department of Agriculture at Ottawa regarding the Exhibition, and that exhibits will be carried and returned free of charge. South Africa is a promising field for Canadian trade. It has been exploited very successfully by American manufacturers and by a limited number of Canadian firms who have had the enterprise to invade that field. For the information of our readers we may mention that the population of Cape Colony at the census of 1891 was 1,527,000, of which 377,000 were whites. The population of Natal was 555,500, of which 42,759 were whites and 43,000 East Indians. The population of Pondoland was 200,000, of Zululand 146,000, Amatongaland 38,000, Swaziland 60,000, Basutoland 218,000, and of Betchulanaland about 66,000; these native territories having so far but a limited white population. The colonies and dependencies just enumerated are all British, but besides these there is the Transvaal Republic under the suzerainty of Great Britain, having a population of about 850,000, of which over 160,000 are whites. Besides the Transvaal there is the Orange Free State with a population of about 210,000, of which 78,000 are white. In the early days of sewing machines the Canadian Wanzer Machine was among the most popular in use in South Africa, and Canadian stoves, office and school furniture, sashes, doors, and house-building material, window shades, bicycles, type setting machines, agricultural implements and other lines of Canadian manufacture, have found greater or less favor in those colonies. American manufacturers, however, have hitherto had the lion's share of the trade because of their greater facilities for shipment and because of their greater enterprise. There is a large market, however, for Canadian goods in South Africa, and it only requires a little investigation to commence on, and a little courage and enterprise to follow it up, to develop a large and steady trade in that quarter of the world. The bulletins which the Canadian Manufacturers' Association propose to publish should serve a very useful purpose in directing Canadian trade into new channels abroad, and in the meantime much can be done by judicious exhibits at such exhibitions as that at Graham's Town.

PURIFICATION OF SEWAGE.*

BY E. G. BARROW, CITY ENGINEER, HAMILTON.

There are few questions of more interest than that of the best manner of disposing of the sewage of our towns and cities, and it may be also said few questions are beset with greater difficulties. When it is considered that this subject has occupied the minds of some of the most practical analysts, engineers and scientists of Europe for many years back, and even at the present day there still exists a great diversity of opinion as to the best method to be adopted, it may well be pronounced a question difficult of solution. It would seem wisdom to avoid becoming a partizan of any particular system, because it frequently happens that the surroundings of a city, the nature of the soil in its vicinity, value of land, etc., dictate the best methods to be adopted in each particular case.

The methods of purification best known at the present time are: 1st. Broad irrigation, or the distribution of sewage over large tracts of land, having in view the growth of useful crops, called sewage farming. This system will take 4,000 to 6,000 gallons per acre per day. 2nd. Land filtration, in which purification is obtained by the passage of the sewage through light soil with little or no attempt to grow crops; 60,000 gallons may be used to the acre on this plan. 3rd. Chemical precipitation, in which the purification is obtained by means of certain precipitants such as lime, alum, salts of manganese, sulphate of iron, which precipitate all the suspended matter in tanks, and also remove a small part of organic matter in solution.

Combinations of the above are frequently made. To these methods have been lately added the septic tank system adopted at Exeter, England; the biological method, by which the purification is sought to be obtained by means of bacteria contained in filters, generally made of coal, coke, polarite, etc.; the treatment lately advocated by Mr. Adeney, of Dublin, Ireland, in which after precipitation with salts of manganese the effluent is treated with nitrate of soda to complete purification.

Ordinary city sewage is a mixture of a very complex character and is derived from the discharge taking place from water closets, sinks, and also manufacturing wastes, and in those cities having the combined system of sewerage, various substances from the streets. The quality of sewage in different cities varies considerably, the difference being largely caused by the nature of the manufacturing wastes which are received into the sewers. A gallon of ordinary sewage contains about 100 grains of solid matter, 30 grains being in suspension and 70 in solution, 60 grains of which are mineral and 40 organic matter, the analysis of which would yield to each 100,000 parts the following results :

---

*A paper read before the Canadian Association of Stationary Engineers.

Total Solids.	Suspended.	Alum.	Free Ammonia.	Organic Ammonia.
140	40	20	5	1

What is required to be done is the removal of all matter in suspension and as much as possible of the organic matter in solution. The organic ammonia or albuminoid ammonia is generally considered by chemists to be the most reliable index of the amount of polluting matter present in the sewage. The removal of the suspended matter is at present best done by means of chemical precipitation, but the effluent so obtained still contains organic matter in solution, which unless discharged into a large body of pure water is liable to set up secondary decomposition. The removal of the organic matter in solution contained in the tank effluent may be almost completely done by filters composed of either coal, coke, polarite, land, etc.

The advocates of the biological method of purification say that the matter in suspension may be liquefied by liquefying bacteria, which are cultivated and sustained by the air and sewage contained in the filter, and by this means the sludge would be entirely done away with. But grave doubts are expressed by sewage experts as to the ability of these bacteria or micro-organisms to perform this office, or in plain language they do not believe that they can "get away" with the sludge, and the opinion is generally held that with average town sewage there will be the sewage sludge accompaniment. A writer on this subject facetiously remarked that if the bacteria can be utilized to eat up the sludge, what a pity it is they cannot be trained to drink up all the liquid.

TANKS.

Precipitation tanks are made both circular and rectangular—their capacity being based on the maximum daily flow of sewage. If the quiescent system is adopted the tanks should be so arranged as to permit the liquid sewage to have at least a rest of 1½ hours. If the continuous flow system be adopted, then sufficient capacity must be allowed so that two hours at least will elapse during the passage of the sewage through the tanks. Provision has also to be made for the tank when not in use, and for the first part of storms. Experience has demonstrated that they should be of medium size, as very large ones have been found more difficult to manage. The parts in contact with the liquid sewage must be smooth, and the sludge drains should have quick slopes towards the sludge well. Experience has shown that no danger from freezing may be apprehended in this latitude in winter time. The precipitants most commonly used are lime, alum, soluble salts of manganese, sulphate of iron.

FILTERS.

A well-designed and well-operated filter, all agree, is a most excellent and efficient purifier of sewage. Formerly it was believed that its action was merely mechanical, or that of a fine strainer. Subsequently it was found that those polluting organic matters in solution contained in the sewage which had an affinity for oxygen underwent chemical decomposition and were transformed into new products of an innocuous nature, and this result was brought about by minute living organisms called nitrifying bacteria, so that in fact the purification was chiefly due to these bacteria. A filter should be so constructed that air can permeate its whole structure. It must also have periods of rest. The most modern way is to allow the clarified tank effluent to completely fill the filter so that the liquid just appears over the top of the filter ; after remaining there for about an hour it is discharged by opening a valve situated at the bottom of the filter. Very good results have been obtained, however, by allowing the sewage to be distributed over the surface of the filter by means of gutters, and allowing the liquid to filter slowly through. The filters should be several in number and each allowed a period of rest. The very best results have been obtained from filters composed of coal, the depth being about 4 feet and the sizes varying from ½ inch cubes to 1-16 inch cubes. It is said that coal produces a better effluent than any other substance experimented with, having a chemical as well as bacteriological action. I have been making experiments with coal filters and also with mixtures of coal and slag, and with sand and coke, and certainly the effluent from the coal filter is the best. It is necessary that all suspended matter be removed before the effluent reaches the filter. Sewage disposal has been more studied and has made more advancement in England, Germany and France than in any other parts of the world, but this has probably been caused, especially in England, by dense populations situated on the banks of comparatively small bodies of water (this does not apply to those cities situated on the seaside); whereas in America with the huge fresh water lakes and gigantic rivers into which the sewage is discharged, evil effects are not felt for many years, and it is only when the cities reach a large size that sewage purification becomes necessary and imperative. Now, both in the United States and Canada, cities and towns are beginning to feel the necessity of disposing of their sewage. Much may be learnt by experience gained in Europe, still I am of opinion that climatic differences and other purely local conditions will lead the American and Canadian mind, so prolific in invention, to perhaps improve on the European methods of purification, or at any rate to evolve some plans which will be particularly adapted to the needs of our climate and country.

The following practical deductions from the consideration of this subject suggest themselves : The sewage farm should only be selected when land situated near the city is suitable in character, and below or very little above the sewer outlets, and of reasonable price. If such land is not available and a high rate of purification is required, clarification in tanks by chemicals, followed by filtration, is the best plan. Collect by means of intersecting sewers all sewage to one station, so that all can be under one management. If part of the sewage needs pumping and part could be carried to purification station by gravity without pumping, then two stations might be the most economical. Such would be our case in Hamilton. In building a filter select the very best material, which I would say, without hesitation, is coal. It will give a better effluent and necessitate a less area than any other material.

The researches and experiments made by Mr. Adeney, of the Royal Dublin Society, on polluted waters, are of great value to the subject of sewage purification. He examined the gases contained in polluted water and the changes which took place in these gases, due to fermentation. These changes were caused by living organisms, and he discovered that it was necessary to supply them with oxygen in order to promote healthy bacteriolysis.

This oxygen he supplied by adding pure water (which always contains a certain amount of dissolved oxygen) to the polluted sewage water, and if sufficient was added purification was completed, but if not, putrefactive fermentation would take place. His examination revealed two distinct stages of bacterial fermentation; the first he called carbon oxidation, and the second nitrification or nitro-oxidation. The first takes place much quicker than the last and the liquid during the last stage will generally take oxygen from the air quicker than the organisms take it from the liquid. The conclusion which Mr. Adeney draws is that if the first stage, viz., bacteriolysis, can be made to take place at the disposal works, then the final stage can be allowed to take place in the river or lake into which the effluent is discharged, provided these bodies of fresh water yield the necessary amount of oxygen to complete the last stage of purification. I have thought that the method of purification advocated by Mr. Adeney is worthy of great consideration, as filters in our climate may not be successful unless covered over, and then the cost of roofing would be very great and require frequent repairs. Especially would this be the case in very large works where the filters would cover many acres. The buildings at the sewage disposal works should be neat in appearance, well lighted, ventilated and provided with al modern conveniences for the employees. Garbage destroyers should be built near the disposal works, so that the heat generated may be utilized to raise steam to run the machinery of disposal works, light the works and dry the sludge where precipitation works are in use.

Before concluding this paper I would draw your attention to one very marked improvement effected by our disposal works. Formerly at the outlet of the Ferguson avenue sewer, large quantities of excreta, animal substances, orange peels, paper, rags and offensive matter imprisoned in grease were discharged from the sewer, and at times were deposited by the wind along the shore where it became putrid and rendered the shore of the bay most offensive. Sometimes huge masses floated out into the bay and were deposited at the beach. Now this has been entirely done away with, and although we contemplated putting in filters at Ferguson avenue works, still I believe very good work has been already done.

SANITARY EXCESS.

BY WM. WATSON.

The Surveyor of London, England, reports an important meeting of municipal engineers held in Greater London, on Feb. 25th, to discuss the various methods of deodorizing and ventilating sewers, and to decide upon a uniform system throughout the municipalities, of public sewer ventilation. The meeting was necessary on account of the difficulties encountered by the municipalities (which have unwisely adopted the United States sanitary system) through the almost constant discharge of sewer gases from the ventilation grates in the centre of the street, and the failure of many expensive experiments made with the object of remedying the evil.

The examinations of the drainage plans of a recently built school in the South of England show the dangerous practices persons will resort to to act up to the fashion of the age. The drain in this case is taken the longest way round to the water closets and lavatories, bending squarely three times, and at each bend there is a catch pit or inspection chamber. There is also an interception trap, a breather, and large inspection chamber, which form impediments to the flow of the solids from the closet to the street sewer, causing a sluggish stream, that deposits the filthy matter at each and every angle and at the interception traps, there putrefying and generating gases that will find somewhere an exit and contaminate the atmosphere. The proper way to have drained the school was to avoid any impediments and run the drain pipe lines as straight and direct as possible from street to lavatories and then vertically above to the highest point of the school roof, having all rain-water leaders branched into the sewage pipe line.

The placing of interception traps on private drains cuts off the ventilation of public sewers, which they formerly secured through the house soil pipe that was carried forward through the roof, and the untrapped drain water leaders which, when in action, discharge large volumes of atmospheric air into the public sewers each time the sewage was discharged down the soil pipe, or when rainwater passed down the leader pipes. Then each and every soil pipe and rainwater leader formed a ventilation up cast shaft for the street sewers at short distances of only a few yards apart, which compelled the rapid circulation of fresh air down the surface grates of the streets and up the local pipes to the housetops. All this purifying element is abolished when the American system of sewer construction and the interception trap is adopted. Most cities and towns of Great Britain which have employed that system have to provide for the deodorizing of large quantities of foul gas that is constantly generating in the sewers, because they cannot now get the circulation of air needed to prevent the sewage and solid matter the sewage contains from putrefying during the time they are passing through the sewers to the outfall at the sewage disposal works. Thus we find that the natural ventilation is prevented. On the other hand it is proved that if sewage be not immediately treated by aerating influences it will commence at once to putrefy in the sewers and work mischief, and artificial methods of aeration or deodorizing must be resorted to or the public health will quickly suffer. It is known by experience that artificial means cannot be relied upon, though they are very expensive.

Under the old dispensation, when owners were permitted to put in their drains of broken pipes, bricks, or wood, with no regard for grading, for fall, or tight jointing, often pointing towards and following quite in the wrong direction, and when there were no general rules or designs adopted for the sewage disposal of the municipality on a comprehensive plan, a large number of such drains were totally useless as sewage carriers, and were nothing but cesspools generating sewer gases and distributing poisonous fluid into the surrounding subsoil. The Government became alive to the dangers of these evils and gave permission for each municipality to enforce such improved sanitary regulations as would effectively stamp out such dangerous practices and compel all drains to be constructed with good material and expert workmanship. When the Act of Parliament became operative a swarm of professional theorists, sanitary appliance manufacturers, interested tradesmen and public works contractors gathered round the various municipal authorities and pointed out to them that it was necessary to thoroughly remove the old sanitary abuses, that intricate and costly appliances, coupled with extremely drastic regulations that required an extensive staff of inspectors and other arrangements to apply them, were needed. Most unfortunately for the public health many municipalities were guided by such advisers and adopted their extreme ideas and thus spoiled the good work begun by overdoing it.

When the unnecessarily drastic regulations were enforced they naturally created a necessity for appliances to counteract the evil done. The natural ventilation which the sewers formerly secured by the large volumes of air carried down the soil pipe by the sewage and rainwater leaders was shut off. The usual and constant circulation of air which formerly passed down the surface grates placed at intervals on the streets, and upward through each soil pipe and rainwater leader to the housetops out of everyone's way, was stopped and the public sewers were then changed from purifiers and destroyers of filth, to receptacles for the accumulation of foul matters and the rapid generators of poisonous sewer gases, which are now found to be very difficult to handle.

To try and destroy the evils thus created, various methods have been tried, and amongst a large number a few of the principal ones may be here mentioned, viz.: The flushing of sewers by water wagons and also automatic flushing appliances, and by creating a current of air with the heat from gaslights burning in the sewers; by connecting the head of each line of sewer o a tall ventilating shaft, or to a manufacturer's mill chimney, or into the ashpit under the steam boilers; by building vaults under the surface, ventilating grates in the streets, and installing deodorizing chemical evaporating machines intended to destroy the foul odors. When these artificial means are put in practice it is found they have each disadvantages unknown to the old natural ventilation processes. It is proved that having one ventilation shaft at the terminating head of each line of sewer is not sufficient, that air shafts are needed between each and all the street grates; that gaslights cannot be made reliable, for they occasionally either smother or blow out and then add to rather than reduce the nuisance. Flushing sewers allow plenty of time for the manufacturing of sewer gases between the periods of flushing, and ventilation is needed even when flushing is adopted. When chemical evaporating machines are used they need to be numerous, one for each grate, and even then the pressure in the sewers due to the want of circulation of air is often such that it forces the poisonous gas through the interception traps, which then passes either into the dwelling through the fixture traps or out of the breather pipes in front of the buildings on which they are placed at a level of within one foot of the ground line. All such apparatus are expensive besides and require constant attention and renewal.

The meeting of municipal engineers and surveyors already mentioned, after discussing the advantages and disadvantages of the different artificial methods of deodorizing sewer gases, decided to advise all municipalities to adopt so much of the old system of sewage ventilation as to ventilate each private drain by taking a branch pipe from the sewer side of the interception trap up to and above the top of the buildings. This is very good by just so much as it returns to the former systems of natural and local ventilation, but it still leaves the interception trap in each private drain that forms a catch bag, and often retains the solids of the sewage that passes through them, and in a short time chokes the private drain and totally disorganizes the house sanitary appliances; it also spoils and destroys the ventilation of the house soil pipes, because when there is any interception between the street sewers, and the terminating end of the soil pipe above the roof, it prevents the warm air of the street sewers from constantly moving upward through the vertical soil pipe and carrying along with it any foul gases that might generate in the waste pipes. To rely upon an upward circulation through a breather pipe placed at the foot of a house drain often fails altogether, because the current of air is sometimes changed to pass down from the roof to the ground line in place of passing upwards, first by the sewage passing down the soil pipes and carrying down large volumes of air with it, which is discharged at the ground line by the breather; second, then very often the breather pipe is not in working order through being choked, and third, by the variations in the temperature of the atmosphere.

The result of the surveyors' meeting proves that the expensive sanitary excesses and the interception trap is a total failure, but that the cost of the system has been thus far heavy and the standing and the reputation of the theorists have to be shielded, so that the intricate and obstructive system must be withdrawn slowly, even if by so doing they still further increase the cost of sanitary appliances. Let sanitarians compare the United States sanitary methods which have been adopted by Greater London and a few other towns of Great Britain, with the large stuff manufacturing city of Bradford, England. The authorities of that city have done everything possible to assist nature to keep their sewage sweet and odorless in the sewers until it arrives at the outfall of the sewage disposal works at Frizenall. The city is crowded to excess with large manufactories and dyeworks that discharge an enormous quantity of dirty or greasy water into the common sewers daily. And 90 per cent. of the population are employed in close greasy factories or other workshops; they live in houses closely built together, yet the inhabitants enjoy general good health, and their death and sickness rate will compare favorably with any other town, even where that town enjoys much more favorable circumstances. This can be largely attributed to the plain and efficient sanitary regulations enforced, and to the adoption of nature's laws in carrying out the principle of domestic sanitation. They do not allow bath or other small waste pipes to be connected directly with the street sewers, but each delivers its contents into an open grid and gully trap which conveys the sewage to the street drain. No sewer pipe which is connected in a direct way with the street sewer enters under any building except to serve a w.c.; then it is constructed of heavy lead or other good metal and joints. Soil pipes that serve water closets in upper rooms are run up outside the building when practicable, and the w.c. bend is taken through the outer wall at the nearest point and connected with the soil pipe outside, and the pipes fixed in this way work all right in frosty weather though the city is visited with long and severe frosts and snows in winter. They also put in as short a length of soil pipe as possible to do the work efficiently; weeping tile drains are never connected with any sewer drain, but deliver on to an open gully grate outside at the bottom of an area window if convenient. The sewage collecting sewers are generally taken along the back lane when the whole of sanitary appliances are in the rear rooms of the dwellings. If allowance be made for the smell that must come from the numerous open privy middens and the slopwater closets which Bradford still uses in many houses, then the city of Bradford is about the sweetest and healthiest manufacturing town that can be found. I may also say that they do not as a rule use back air vents to water closets; and it is unnecessary to use them for the traps, serving baths and any other small fixtures, because they are not connected directly with the sewers.

John Burke, Esq., North Bay, has secured a contract for lighting the streets of North Bay by electricity, and has placed an order with the Canadian General Electric Company, for a 25 light wood arc dynamo, and 15-double carbon brush arc lamps.

THE VICTORIA JUBILEE BRIDGE.

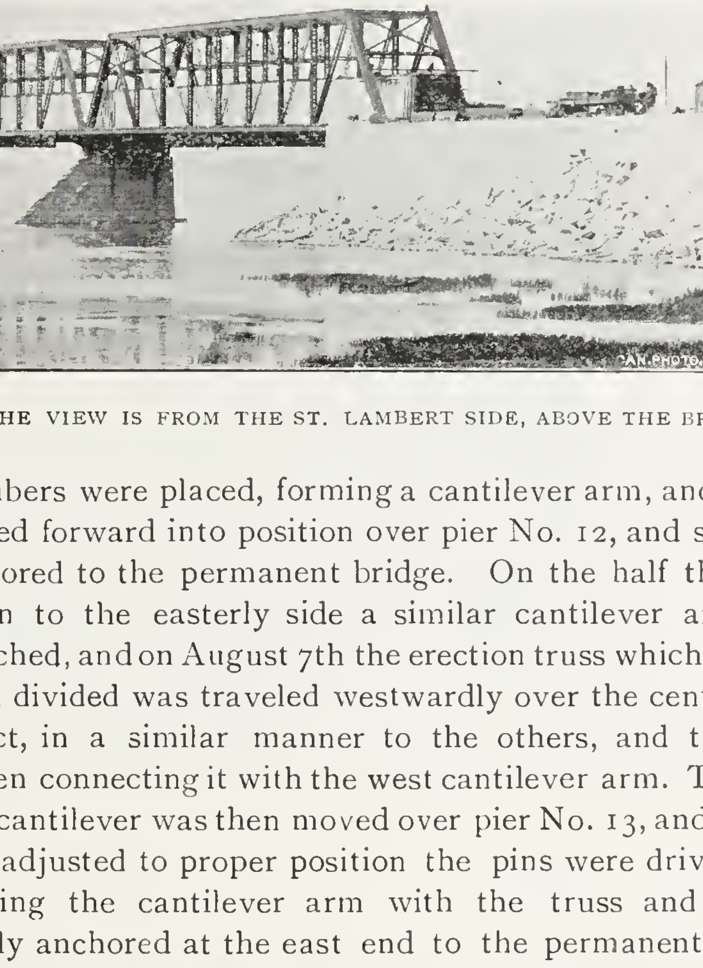
The Victoria Jubilee Bridge, on which such rapid progress has been made during the past few months, is well under way towards completion; in fact, it may be already said to be completed as far as being self-supporting is concerned, for no portion of it is now dependent upon the erection trusses, and the double line of rails will be laid throughout, just as soon as the old tubular bridge is removed. The work of erecting the superstructure of the first span from the westerly end was commenced on the 8th December, last year, and it was completed on the 25th of the same month; but as it was almost impossible to carry on further operations during the winter season, the work of erecting was suspended until last spring. The second span was commenced on March 23rd, and the work progressed steadily during the season, with the result that on the 19th August the central span, which was the last one to be done, was all coupled up and resting upon its own bearings, thus practically completing the bridge proper. This has certainly been rapid work in bridge erecting, considering that between the 23rd March and 19th August, twenty-three spans, of 254 feet each, for double railway tracks and double tramways, and one 348 feet central span, of similar capacity, were erected in place, and that during this period of five months the aggregate amount of time that the present single-track bridge was closed to train service was only twenty-five hours.

VICTORIA JUBILEE BRIDGE, MONTREAL, SHOWING UNFINISHED CENTRAL SPAN. THE VIEW IS FROM THE ST. LAMBERT SIDE, ABOVE THE BRIDGE.

The method of erecting the 254 feet spans has been described from time to time, and was carried on throughout on the same general principles. A temporary truss of as light a character as was compatible with what was required of it, was erected in proper axis on the ground at the entrance to the present bridge, and traveled across the tube by means of a series of trucks moving on the rails on top of the tube. Blocking was placed on these trucks to carry the truss by means of its top members, and the wheels were so placed as to distribute the weight as uniformly as possible in passing over the tube. The temporary truss was then drawn across the tube by means of block and tackle, worked by a stationary engine, securely placed on the top of the next tube.

As instance of how perfect the arrangements were for the moving of this temporary truss, it may be stated that the time occupied in the actual passage from pier to pier was only from four to six minutes in each case. After this truss had been placed exactly over its bearings on the piers it was lowered into place and the entire weight removed from the tube. During its passage over the present bridge and until it was securely placed upon its own bearings on the piers no trains were allowed to pass through the tube. This temporary truss being twenty-six feet two inches wide and thirty-four feet ten inches high, centre to centre of post and chords was therefore completely clear of the tube, and was then used as the staging for the erection of the permanent bridge. There were two erection trusses, one on each side of the centre, and as each permanent span was completed, the erection truss was moved in a similar manner for the erection of the next one.

The central span being so much greater than the others required a different method for the temporary work, and therefore the two erection trusses were used to form one. The plan adopted was unique; the one used on the westerly side of the centre was cut in two, and one portion of it removed to the easterly end of the one used on the easterly side. On the portion that remained some extra members were placed, forming a cantilever arm, and it was moved forward into position over pier No. 12, and securely anchored to the permanent bridge. On the half that was taken to the easterly side a similar cantilever arm was attached, and on August 7th the erection truss which had not been divided was traveled westwardly over the centre tube intact, in a similar manner to the others, and the pins driven connecting it with the west cantilever arm. The east end cantilever was then moved over pier No. 13, and after it was adjusted to proper position the pins were driven connecting the cantilever arm with the truss and it was firmly anchored at the east end to the permanent bridge.



THE ELEVENTH PIER AND SECTION OF TWELFTH SPAN.

The blocking on the trucks which supported the truss and carried it across the tube was then removed and this temporary span then rested on its own bearings, all foreign weight being entirely removed from the tube. Notwithstanding the exceptional care which had to be exercised in placing this truss, the time that the present bridge was closed to traffic was only five hours.

In regard to work remaining to be done in connection with the bridge proper the removal of the old tubes will be the most laborious; the first span of the tubular bridge has already been taken away and it may therefore be said that that portion of the new structure is now in active use. The cutting of the rivets of the old structure and the removal of the various plates, girders, etc., entails an immense amount of labor, and it is of such a nature, and the field for operation is so limited, that the greatest care and caution have to be exercised in this particular part of the work, more especially on account of the incessant traffic moving in either direction.

VICTORIA JUBILEE BRIDGE, MONTREAL, SHOWING OLD TUBE SURROUNDED BY NEW STRUCTURE.

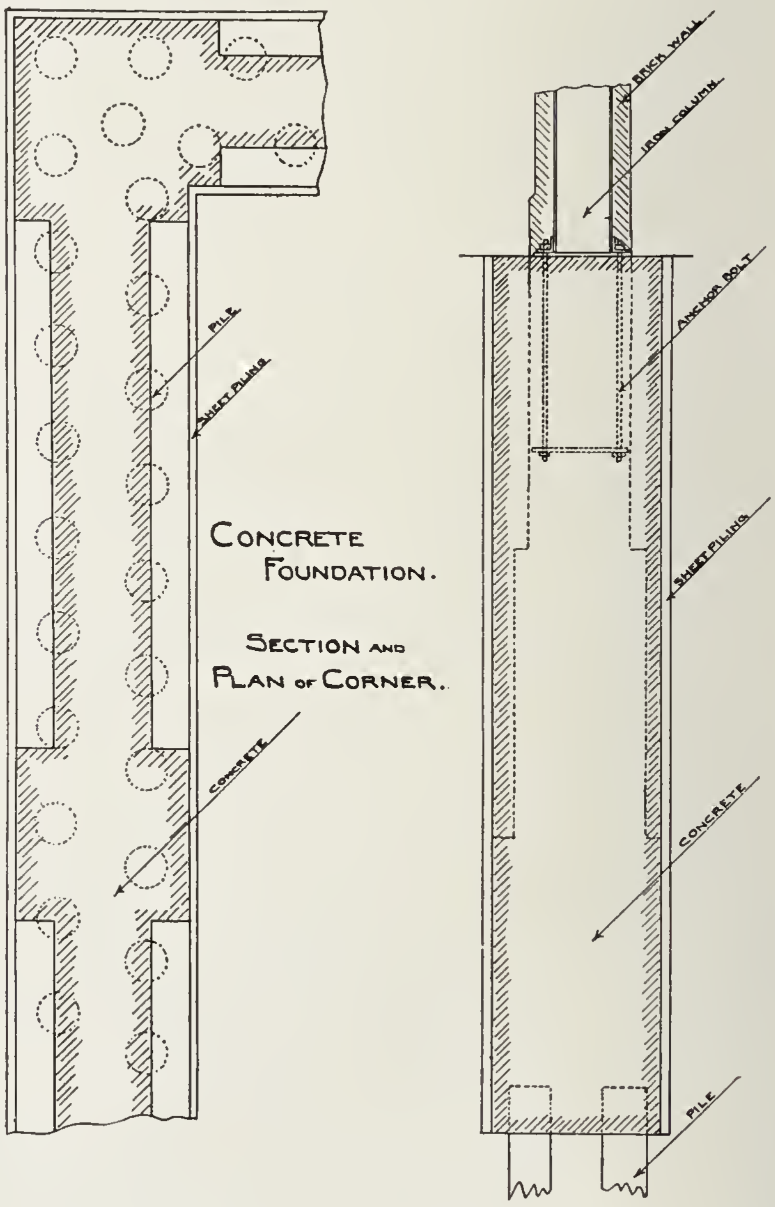
The old tubular bridge, as is well known, is a single-track structure, with a minimum clearance in height of only 15 feet. The new bridge will have a double line of railway tracks and a clear headway of 22 feet 6 inches. It will also have a team roadway and sidewalk on either side of the bridge outside the main trusses, which will be carried by the floor beams extended beyond the trusses. The total length of these floor beams is 66 feet. By way of comparison it may be interesting to note that the weight of iron-work in the old structure is 9,044 tons, whilst the new contains 22,000 tons of steel. Amongst other work yet remaining to be done is the widening of the embankment approach to accommodate the team traffic, but that is a minor matter, and will not interfere during its construction with the train traffic, nor yet with the bridge itself.

A CONCRETE FOUNDATION.

A somewhat unusual foundation has just been built for a new generating house the Consumers Gas Co. is erecting on Parliament street, Toronto. We believe it is the first of the kind in Canada. The building is to replace one that had to be torn down on account of the numerous cracks and settlements developed by faulty foundations. The foundations for this heavy building were simply rubble stone walls in lime mortar, walls that were built without any through bonders, plenty of "shiners," straight joints, parts laid up dry and all small stones; consistently with such work the walls were largely built on a soft made up bottom, one wall was carried down indeed sixteen feet below the ground level as if in search of hard bottom, which not only caused useless expense in the first instance, but also made the expenditure greater in the new work. Had piles been driven from four or five feet below the surface all round the building until they either gave an equal frictional resistance or reached hard pan, the first building would have cost less than it did and still be standing. This is a glaring instance of the greater costliness of rule of thumb methods in building over more scientific ones.

When the old foundations were removed the architects had test piles driven at intervals of about ten feet along the trenches and found the bottom to be so soft that the piles sunk to rock without practically developing any frictional resistance. Calculations were made therefore on the basis of the piles acting in direct compression, and from data thus gained it was determined to drive a double row of piles in the trenches at two feet centres staggered. These piles averaged a depth of about twenty-six feet from the ground level. They were cut off perfectly level twelve inches above the bottom of the trench and concrete filled in between to an even surface with the tops of piles, this thoroughly keyed the piles together and gave a good bed to build on.

On the recommendation of the architects, Bond & Smith, Toronto, solid concrete walls were then built to the ground level, part being sixteen feet deep. With walls such as this the loads from the superstructure (a steel skeleton building) are quite evenly distributed on the piles; Another point is that the column bolts are bedded right in the concrete mass and the whole is cohesive and rigid. The walls were stepped up in thickness from 3 feet 6 inches to 2 feet 3 inches.



The method of mixing and laying may be of interest: The concrete was formed of five parts of small broken stone, two of gravel and one of cement. After carefully examining tests of various cements a Canadian brand was specified by the architects, the Samson brand of the Owen Sound Portland Cement Co. All proportions were carefully measured in barrows of equal capacity, the stone was thoroughly wetted before being mixed with the other materials, the mixture was turned over four times to ensure thorough covering of the stone, only enough water was allowed to be added to make the mass cohesive, it was then placed in the trench and tamped until the water came up to the surface. The walls were made in layers of not more than eight inches and wherever a joint occurred the layers above lapped over at least five feet in either direction; always before starting a new layer the lower one was "ragged" up, swept clean and watered thoroughly.

It is somewhat strange that this method of concrete foundation walls has not been more extensively used, for it is not only superior to an ordinary bonded wall, but has been found to be cheaper than a stone wall properly built in cement; doubtless though we shall see it adopted more often in the future now that a beginning has been made.

Some difficulty was experienced in carrying out this work through the heavy generators bearing on the ground a few feet from some of the trenches. On this account before allowing the old walls to be removed three-inch sheet piling was driven sixteen feet down. As the stone was taken out wales were placed along this and carefully strutted. At one of the other trenches it became necessary to underpin the stone wall of adjoining building before proceeding with the work.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NINTH ANNUAL CONVENTION.

The ninth annual convention of the Canadian Association of Stationary Engineers was held at Hamilton, on the 8th, 9th and 10th August. The hotel headquarters were at the new Waldorf House, and the meetings were held in Oddfellows' Hall, John street.

The first session opened at 11 a.m., on Monday, 8th, with president, Bro. E. J. Philip, of Toronto, in the chair, and vice-president, Bro. W. F. Chapman, of Brockville, in the vice-chair. The other executive officers present were, J. G. Robertson, Montreal, secretary; R. C. Pettigrew, Hamilton, treasurer; G. C. Mooring, Toronto, doorkeeper. The delegates present from the branch associations were: Charles Moseley, John Fox, Wm. J. Webb, and Thos. Eversfield, of Toronto No. 1; John M. Dixon and John J. Richardson of Toronto No 2; Thos. Ryan and Peter McNaughton of Montreal No. 1; Geo. Mackie of Hamilton No. 2; Chas. Asselstine of Kingston No. 10; Wm. Allan, of London No. 5; John Grundy, of Brockville No. 15; Wm. Bear of Dresden No. 8; Wm. Oelschlager of Berlin No. 9; Thos. Pilgrim of Brantford No. 4; and John L. Wendell of Waterloo No. 17.

Other members reported present were the officers of Hamilton No. 2, consisting of Robt. Mackie, president; W. R. Cornish, past president; Thos. Chubb, vice-president; Joseph Ironside, recording secretary, James Carroll, financial secretary: Wm. Nash, treasurer; W. I. Stevens, conductor, and Thos. R. Carter, doorkeeper; Peter Stott, T. Cook, C. Hurton, J. Webb, T. Elliott, C. De Mille, W. Morris, J. Wadge, J. Clair, J. Fielding, David Hunter, Robert Stewart, J. M. Morris, and G. Epps, all of Hamilton; Geo. Gilchrist, Geo. Bradley, A. M. Wickens, Samuel Thompson, Walter G. Blackgrove, J. G. Bain, John Ruse, P. Trowern, all of Toronto; F. G. Mitchell, of London.

Among the visitors present were J. E. Taylor, representing the International Correspondence Schools, Scranton, Pa.

Executive treasurer Pettigrew, having introduced Mayor Colquhoun, and Aldermen Carscallen and Nelligan, of the Hamilton city council, the Mayor came forward, and in the name of the council and citizens, welcomed the association to Hamilton. The duty demanded of him was a pleasing one, for societies with such high ideals as this should meet with hospitality and friendship, wherever they convened. His chief regret was, that owing to the restrictions of a city by-law, which was as unchangeable as the laws of the Medes and Persians, he could not offer them the use of the City Hall as a meeting room, but he was glad to see they had comfortable quarters and plenty of room here. He hoped the delegates would carry back with them the most kindly recollections of their visit to Hamilton. They would be welcomed and "taken in"—using that phrase in a hospitable sense—and they would find the people of Hamilton kind and fraternal. Hamilton was a city to be proud of; it was of no mushroom growth; there had never been a boom since 1856, but its growth had been a steady, legitimate one, and that was what they wanted. Hamilton was now becoming known as one of the prettiest cities on the continent of America—an assertion with which the visitors would agree, he believed, before the convention was over. He might say more, but he was not an adept at figures of speech. As a banker he was more familiar with the figures that could not lie (laughter). In conclusion, he welcomed the delegates collectively and individually, and trusted their convention would be both pleasant and profitable.

Alderman Carscallen wished to emphasize the welcome extended by the Mayor, and was glad the association had seen fit to choose Hamilton as a convention city. He had been struck with the principles of this association, as announced in the preamble of the constitution, which he begged leave to quote: "This association shall at no time be used for the furtherance of strikes, or anyway interfering between its members and their employers in regard to wages, recognizing the identity of interest between employer and employee, not countenancing any project or enterprise that will interfere with perfect harmony between them; neither shall it be used in any manner for political or religious purposes." As long as this association is conducted on those principles, it would have the respect of every right-thinking man, and he would admonish all the members to adhere to those principles. He had always been in favor of organized labor, for the improvement of the condition of the workingmen, and as a means of obtaining their rights; and he had no hesitation in saying that the organization of labor had been the means of lifting men up. Union for mutual help and defence of interest was reasonable and seemed to prevail. As a councillor of some years' experience he would advise them never to be hasty in amending the constitution. A proposition might appear reasonable at first sight, but on second thought it would be seen to be a mistake. He hoped their deliberations would redound to the credit of the association.

Alderman Nelligan also expressed the pleasure it afforded him to join in welcoming the association to Hamilton. In the city council he was an advocate of day labor, as a means of getting good and efficient work, instead of awarding municipal work to contractors, who would squeeze the men and get all the profit there was in a job for themselves. He hoped the delegates would have a good time, and be pleased with their stay in the city.

Bro. Robert Mackie then read an address of welcome on behalf of the Hamilton branch, as follows:

"On behalf of the Hamilton Association No 2, I have a great deal of pleasure in extending to you, delegates of the Canadian Association of Stationary Engineers, at our 9th annual convention, a hearty welcome to our city. We might say that you are not strangers in a strange land, for you have been here at a former meeting of this kind, the Executive having been formed in our city. The continual growth of the association, however, has brought with it a larger number of delegates. It is not necessary to go into details of the advantages of engineers belonging to such organizations as ours. The members of the Hamilton branch received a great deal of valuable information last winter by a series of addresses and papers on subjects in which we are all deeply interested, given by the best authorities we could procure. In conclusion, we trust your stay with us will be a very pleasant as well as a profitable one."

The president appointed Bros. Ryan, Wickens and Blackgrove a committee to draft a reply to the addresses of welcome.

The president gave his annual address as follows:

I have the honor and pleasure to welcome you to this the 9th annual convention of the C.A.S.E. The subordinate associations have chosen you to represent them at this convention, and to look after their individual interest in particular and the whole society in general. The second meeting of the executive —it was really the first, the previous one being only a meeting to get into shape—was held in this city, and I little dreamt at that time that I would occupy the president's chair at the next meeting in Hamilton; therefore, it is with pleasure that I greet you, the new members and the jolly good fellows I have met before. While this meeting should be a criterion by which we can judge the growth of the association, we must not forget the conditions under which the C.A.S.E. is carried on. First, it is not a labor organization, nor is it an insurance society, and it cannot be called a secret or benefit society, nor is it a political or religious order, it is purely an educational institution. Therefore the growth of the order is limited for several reasons. First, we have not the attraction that insurance, secret, benefit or labor organizations have. The field from which we draw our members is limited and scattered, and there are few places where there are plants enough to get a number of engineers to join an association; another reason is the fact that as boys at school hate to be taught, so we grow up, and it is hard to get a man to realize that he has much to learn, and as education is the only object for joining the association some object to letting the public know that there is anything yet for them to learn. Now, while the growth of the order is apparently small, at the same time the percentage of good done its members is much greater than any other order that I know of, as many can testify to. We meet again here this year to try and work out other ideas for the benefit of the order and each member individually. I hope you will all give your attention to the business that will come before you, that our meeting here may result in profit to ourselves and prosperity to the society. The prospects for the coming years are brighter than for years past; times are good in this country, and when the war is settled the big country to the south of us will brighten up and their prosperity will add to ours. So that if we grew in the past few years we will boom in the next. Hard times have had their effect on this order like all others, but hard times are a thing of the past in this country, and will be for some time to come, if I am any prophet, and if those who have been the stay of the association in the past will keep on pushing they will reap the harvest they have been looking for. Better work has been done in the subordinate associations during the past year, in the line of reading papers and making the meetings entertaining and instructive than other years; and it is noticeable the improvement in lodges where this matter is thoroughly carried out. I am pleased to state that Hamilton No. 2 is carrying this work out to perfection. There was one new association formed during the year in Toronto. It is a good live association and will materially help the order in Toronto and vicinity. The matter of a hand-book taken up last year was completed this. The secretary will no doubt make you a full report on the matter. I have not had the time to give to executive business that I would like, from the fact that this has been the busiest year with me that I have ever experienced, in fact, it was very difficult to get away to attend this convention; in consequence of this the work has all devolved on the secretary, and, as in past years, the secretary is by far the more important officer of the executive. So much so that it has been suggested that a permanent secretary be appointed, or at least have the secretary hold office for more than one year. As it is now, it takes a man the entire year to get accustomed to the work, and then he is changed, making confusion and loss of time to both executive and subordinate lodges that would be avoided by a permanent secretary. In conclusion, brethren, I hope you will give me the support that you have given the chair in the past, and that you will attend strictly to business while there is business to be done. I wish it were in my power to do all for the C.A.S.E. that I would like, and place it at the head of all societies, where it belongs, because it is founded on education.

Bro. Wickens regretted that duties in Toronto would call him away from the convention for the following day, but as he took a fatherly interest in the organization, having been one of its founders, he desired, with the president's permission, to make one or two observations before leaving. There were many different associations in existence, with various objects in view, but no association bearing on trade could be named which existed for the special purpose of educating its own members. The C.A.S.E. did this, and spent hundreds of dollars for the educational advancement of its members. How to extend and develop the educational plans of the association was a problem. Many engineers were scattered over a wide extent of territory in Canada, in many places it was not possible to form a branch association, and how to extend these advantages to such engineers was a problem worthy of consideration. He was glad to see city aldermen here, and would be glad to see city fathers in other places take an interest in our association. It was well for them to know that this association existed as much for the steam user as for the engineer. If the ideals of the association are lived up to, there was nothing to prevent it from becoming one of the greatest organizations in the country.

Secretary Robertson then read the minutes of the last convention, which, on motion of Bro. Moseley, seconded by Bro. Mooring, were approved.

President Philip nominated Bros. McNaughton, Mooring and Geo. Mackie to be the Committee on Credentials.

In the absence of Bro. Risler, of London, Bro. Allan, of the same branch, was appointed conductor.

Bro. Oelschlager, of Berlin, said, that as he would not be able to remain throughout the convention, he would take this opportunity of inviting the members to hold the next convention in his town. Berlin could not boast a big river or lake, but it had other attractions, and was becoming known as a convention town. Berlin was a prosperous manufacturing town, and he could assure the members that if they accepted his offer they would find a hospitable welcome.

Bro. Wickens approved of the idea, as Berlin and Waterloo, which were almost one, had each a branch association, and the Berliners knew how to take care of a convention.

The formation of committees was then proceeded with, as follows, the first-named member in each case being chairman:

Committee on Audit—Bros. Webb, McNaughton and Bear.

Constitution and By-laws—Bros. Ryan, Mooring, Allan, Filgrim and Geo. Mackie.

Good of the Order—Bros. Dixon, Chapman, Eversfield, Moseley and Richardson.

Mileage—Bros. Pettigrew, Robertson and Fox.

Bro. Ryan gave notice of motion to have the following changes made in the constitution and by-laws:

1st. That the per capita tax paid by the different sub-associations be reduced from 70 cents per member, as at present, to 50 cents per member. ......

2nd. That with a view to reduce the expenses of the Executive Council, the meetings of the Executive be held bi-annually instead of annually.

3rd. Also with a view to reducing expenses, that the election of doorkeeper and conductor be dispensed with, and that these offices be filled at the convention by any delegates appointed by the president.

4th. That no District deputy be appointed by the president, but that all the executive officers fulfil the duties of District Deputy in different localities at any time.

5th. That all past presidents be competent to form part of the Executive Council with full powers and privileges, but that no mileage or hotel expenses be paid to any past president.

Bro. Wickens gave notice of motion that the Committee on Constitution and By-laws be requested to formulate a set of by-laws for the subordinate associations, and report the same at next convention.

The convention then adjourned till

Tuesday, 9th Aug.

The first business of the day was the presentation of the executive secretary's report. Secretary Robertson reported that during the year a new branch association had been formed in Toronto, known as Toronto No. 2, and they had succeeded in resurrecting the two defunct branches, Stratford and Wiarton. From Guelph, Ottawa, Winnipeg, Kincardine and Peterboro no report had been received as to per capita tax. The receipts of the year were $555.99, and after paying expenses the association had a balance on hand of $290.04. These figures did not include the expenses and receipts of the new handbook, which had not been issued long enough to enable them to make collections. This handbook had been compiled with a view to making it as useful as possible to the average engineer, and it had been exceedingly well received. It was acknowledged to contain more information than many books of five times its price. It was too early yet for the association to reap the full benefit from it, but that would come in the future. The financial results from it would be fully reported on at the next convention, and meantime he might say that he hoped to turn in several hundred dollars to the association from it.

On motion of Bro. Pettigrew, seconded by Bro. Allan, the report was adopted, and Bro. Robertson and his co-compilers of the handbook were congratulated on their excellent work in producing such a valuable book at so much labor and trouble to themselves.

The Treasurer's report was as follows:—

The Treasurer begs to submit the ninth report of the Association.

Balance from last convention and receipts of the year	$559 99
Expenditure	269 95
Balance on hand	290 04

ROBERT C. PETTIGREW.

Auditors: W. J. Webb, Wm. Bear and P. McNaughton.

On motion of Bro. Mooring seconded by Bro. Asselstine, the report as passed by the auditors was adopted.

Bro. Ryan presented the report of the committee on constitution and by-laws as follows: This committee recommends unanimously the following:

1st. That the per capita tax be reduced to 50 cts. per annum for all members in good standing.

2nd. That the doorkeeper and conductor be not elected but appointed by the president from the delegates present at each meeting of the Executive Council.

3rd. That in article 10 section 1 the word "deputy" shall be struck out and "Executive Officer" inserted.

4th. That all past presidents remain members of the Executive Council with full privileges, but they must defray their own expenses.

5th. That the committee does not see its way clear to hold its conventions bi-annually.

Bro. Dixon presented the following report of the committee on Good of the Order. Your committee appointed to consider this important portion of our Society's life and development, have given due thought to the many suggestions that have been presented, and would submit the following conclusions to the mature judgment of the convention.

The president's report in a spirit of fraternity, welcomes all to take part in the convention. He further adds that our society is neither a trades or insurance association, and consequently our expenses should be reduced to a minimum. The educational portion of our meetings should have some form of systematic teaching, and all who are able should be asked to participate in this necessary and useful work. We believe that an advance in this direction would be instrumental in raising our organization to a permanent and educated membership.

We believe the time inopportune to change the per capita tax as the executive have liabilities which must be met for the current year, and any action taken in the matter might be a source of discredit to the order at large.

The suggestion of bi-annual meetings we regard as a fatal blow at our very existence. The vitality of a society consists as much in its intercourse and annual settlement as it does in its financial strength, and while the desire to economise may be commendable, yet we regard this step as one which in a measure would be suicidal.

The cutting off of doorkeeping and conductor proceeds from the desire to further economise, but we submit that such a course may act prejudicially, inasmuch as the conferring of this honor on members of small or remote associations keeps a thread of connection that is frequently of eminent service to the Order.

The services of district deputies should be dispensed with, and in the locality requiring the service of an executive officer, any member of the executive should be delegated to discharge the duties of the office.

The bulletin at present issued monthly to the associations should be enlarged to an 8 page Journal. It could be made an avenue of interest and information to our membership, besides it could be placed in the hands of those eligible to join our ranks, and possibly add materially to our numerical strength. We are further of opinion that such a sheet, by proper management, could be issued free of expense by a judicious system of advertising.

The office of executive secretary is one that should be held for more than one year, as a greater degree of perfection could be reached in secretarial work by a continuous service. The price of stationery as furnished to primary societies is on the side of excess, and we would suggest that a reduction of 10 or 15 per cent. should be made on all future sales.

It is a matter of regret that our bill in the Dominion Parliament was thrown out on a technicality; but we trust the combined wisdom of the present convention will devise some method wherein our profession may have due recognition and legal protection.

Both reports were received, to be discussed in detail later on. In the meantime a general discussion took place on the effect of the proposed changes.

Bro. Ryan said other organizations larger than this had got into trouble through fixing their per capita assessments too high, and there were some members of the Montreal association with whom this was a serious matter. Bro. Moseley wanted to know, if this tax were reduced, where the funds would come from to make up the deficiency. Toronto No. 1 had no complaint to make, as it had double the membership of any other branch; but a reduction all around would leave a shortage. He thought it should be left for another year. Bro. Pettigrew was in favor of a reduction and the association was now in shape to make it. Bro. Dixon said that big societies could afford to have a low assessment. He wished to be on the side of economy, but the present time was not opportune, and the branch association should be consulted in such a matter. Bro. Robertson said that as far as the immediate future was concerned, the association at large really depended for its income on the handbook just issued.

After further discussion Bro. Dixon moved, seconded by Bro. Richardson, that the executive secretary issue a circular to all the branch associations, asking them to state their financial position and express an opinion on the question of reducing the per capita tax, a report to be presented on the subject at the convention of 1899.

In speaking to this motion, Bro. Ryan said Montreal No. 1 had already instructed him on the matter. Bro. McNaughton said the dues to the branch associations barely covered the expenses, and if the per capita tax were reduced it would give them a fund to work upon. Bro. Moseley said Toronto No. 1 had been able to make way and pay out $200 in sick benefits in the last two years besides. Bro. Asselstine said Toronto was exceptionally well fixed. In Kingston, they found the tax quite a burden. Bro. Robertson said the big branches should help the little ones, if they wanted to see the institution grow; but he did not see how they were going to reduce the tax. President Philip, in reply to a question, said the proposed change in the officers would take off about two-thirds of the average loss from the reduced tax. On motion of Bro. Robertson, seconded by Bro. Moseley, the discussion was deferred; Bro. Dixon's amendment being lost.

On resuming discussion on the report of the Committee on Constitution and By-laws, the first clause, proposing to reduce the per capita tax, was defeated.

On the second clause, Bro. Dixon thought that if these offices were retained, the delegates elected—especially if from a small branch—would go back to their branches as apostles of the association. Bro. Ryan held that there were as good men in the small branches as in the big ones for any office, but as these offices could be filled by any delegate present, it was only throwing money away to have them as a part of the executive machinery. On being put to vote, the clause was rejected, and the offices of doorkeeper and conductor retained.

Clause 3 was adopted, the effect being to do away with the "district deputies," and make each executive officer an organizer in the district in which he may be visiting, or may reside.

Clause 4 was also carried, giving past presidents the right to vote, etc., at conventions, but without transportation allowance.

Clause 5 was also approved, maintaining the conventions annually, as at present.

On taking up the report of the committee on "Good of the Order," the president said Mr. J. E. Taylor, of the International Correspondence Schools of Scranton, Pa., would like to address the convention on the educational question. Permission being given, Mr. Taylor gave a history of the beginning of this institution, which was founded by T. J. Foster, first as a means of preparing miners and mine engineers to pass the examination required by the State of Pennsylvania, and afterwards as a more comprehensive system of technical education for steam engineers and firemen, electricians, machinists, mechanical draughtsmen, designers, etc., to be carried on by correspondence in any part of the world. When the State law, requiring the examinations, was passed, many of the miners were in a difficulty, and Mr. Foster was asked to help them out by a set of questions and answers. It was thought that a class of 300 might be obtained at first, to cover expenses, but when the plan was placed before the men, 1,200 applied, and the idea has since developed, till now the I. C. schools have 50,000 students throughout the world. The student is taken right from the a b c of arithmetic up through algebra, etc., and as a correspondence is carried on personally with each student, a fair chance is given to backward pupils. The postage bill of the institution averages over $1,000 per week. Recently a kind of employment bureau has been started for obtaining situations for students, after they have passed, and a case was cited where the institution had been the means of obtaining situations for three young tool makers, at wages of $3.50 per day. The schools have 15 printing presses run by electric motors, and consume about two tons of paper per week.

A special discount was now offered to members of the C.A.S.E., and Mr. Taylor was prepared to explain all details to members interested. A branch office is being opened in Toronto, particulars of which are given in another column.

On motion of Bro. Dixon, seconded by Bro. Richardson, it was decided to recommend the methods of this school to the consideration and support of members.

On the question of continuing the issue of the "Bulletin," published for the past four months, Bro. Robertson explained that it was got out to advertise the work of the Engineer's Handbook, 1,000 copies per month being printed. It had served that purpose well, and the question now remained as to its continuance, either as a 4-page or an 8-page paper.

After further discussion, a committee, composed of Bros. Ryan, Dixon and Robertson, was appointed to confer with the publishers of THE CANADIAN ENGINEER in regard to the issue of the bulletin.

The convention then adjourned to hold an excursion on the steamer "Acacia" during the afternoon. About 50 joined in the trip, the steamer crossing Hamilton Bay and making a trip several miles out into Lake Ontario. A lunch was served on board, and the trip was enlivened by song and dance.

At the evening session E. G. Barrow, C.E., city engineer of Hamilton, read a paper on sewage disposal, which is printed elsewhere in this issue.

In complimenting Mr. Barrow on his instructive paper, President Philip said this was an important subject for Canadian cities and towns, and one that must be studied more seriously by our municipal authorities. Toronto, among other cities, stood in need of reform in its sewage system. There was one question he would like to ask Mr. Barrow, and that was the effect of the filtering operations on the coal used in the filters.

Mr. Barrow replied that after being used for two years in the filters, the coal was found to be as good for burning as before—in fact its burning qualities seemed to be improved, probably owing to the oily matter absorbed during its use. In reply to another question he said any kind of coal could be used, but it must be of small size.

Bro. Moseley asked what was meant by giving the filters a "rest?"

Mr. Barrow said that it meant the exposure of the material to the open air and sun, for an hour or more.

Bro. Geo. Mackie asked as to the relative value of coke or charcoal as a filter medium.

Mr. Barrow replied that they were not considered so efficient as coal. Replying to Bro. Mitchell, he said the sewage to be treated could be made to go up through the filter by pressure or down through it by gravity. The first layers of coal were coarse, and then finer coal was put on down to 1-16 inch. In reply to Bro. McNaughton, he said that in carrying out the irrigation system, it was desirable to make the area of ground broad enough to absorb the sewage without soaking the ground too much. On this account, in some localities, and in wet seasons, it resulted in too much soaking of the soil. The sewage was distributed over the ground by carriers. In the method of underground filtration, the most successful work was done at Berlin, Germany, where the soil was light and porous, and readily absorbed all the sewage. Replying to a question of Bro. Stott, he said that with the lime treatment a disagreeable smell developed, unless the treated material was quickly removed, but it was not so when the material was treated with manganese, which made a better precipitant.

J. M. Williams, of the chemical laboratory of J. Winer & Co., wholesale druggists, Hamilton, then read a paper on "Oils in the Engine-room." This paper will be found elsewhere.

The president, in complimenting the reader of the paper, said it was exactly in line with their work, and although many of them did not pay much attention to the composition of oils, all used them, and should be well posted on their nature.

Bro. Mooring would like a simple test of engine oils.

Mr. Williams said an oil was good, according to the degree of its viscosity, or body, and to test this in a simple way take a can and make a hole large enough to let out a drop at a time. Take a standard oil and count the drops that will come out of this hole per minute, and compare that with the outflow of the oil to be tested. To make the test fair, you must use the same can and the same hole, with the same amount of oil and at the same temperature for both oils. It is still better if two tests are made, one at a high temperature, and one at a low temperature. A viscometer is a desirable apparatus for such tests. As to testing the volatile properties of an oil, this can be done by placing a given quantity in a wide, open vessel and letting it stand a given time to see how much it will lose in bulk by evaporation. The oil that evaporates most is the poorest for lubricating purposes. Coal oil, for instance, which is very volatile, is of no use at all as a lubricant. Neither should an oil be gummy. Heating it in a vessel will disclose whether an oil is gummy, but this trouble will be found chiefly with oils that are derived from fish, or from animals and vegetables, and as most lubricating oils in this country are now of mineral origin, this difficulty is not common.

Bro. George Mackie asked if the volatility of two samples could not be disclosed by placing a drop from each on the cylinder and seeing which dried up the sooner. Mr. Williams replied that such a test was practical and convenient.

The president observed that some oils will run very slowly and yet be of no use on a heavy fast-running journal. He was one of the first who began to use light oils, and though he found the first trials unsatisfactory, one of the representatives of the Standard Oil Co. came around, and, after carefully going into the matter, proved that the difficulty arose, not from the new oil, but from the oils previously used, and after the bearings were cleaned of the former oils, all went well.

Bro. Moseley thought the best test of an oil was the crank-pin of a high-speed engine, running at 270 revolutions per minute.

In reply to Bro. Geo. Mackie, Mr. Williams said that any oil having resinous constituents (that is, of the nature of rosin), adds to the resistance in the bearings and increases the coal bill. In reply to Bro. Mitchell, regarding cylinder oils, he said there was no doubt that wet steam prevented lubrication in the cylinder. If the flash test was low it would be found that the oil, when put into the cylinder, would vaporize, or turn into a sort of steam, and therefore be no good as a lubricant. After discussing a particular experience of Bro. Mitchell, in testing a new cylinder oil, he would say that the flash test should not be too far in advance of the temperature of the steam in the cylinder, at 100 lbs. pressure. In response to a request for tests for oils, together with the usual ones of exposure to high temperatures for volatility, and drying, he suggested to have a bottle marked into thirds and shake together one-third of the oil in question and one-third clear lye (made by dissolving commercial canned lye in water and decanting); after standing mineral oil will rise to the surface, any animal or vegetable oil will be saponified and remain in the lower layer with the lye.

On motion of Bro. Moseley, seconded by Bro. Ryan, a vote of thanks was passed to Mr. Barrow and Mr. Williams for their interesting papers, and for the quiet way in which they had stood the cross-examination of members.

Bro. P. McNaughton then read a paper on "Evaporation and the Raising of Steam in Boilers," which will be found in another part of this issue.

President Philip said this paper disclosed a more than usual amount of study on this subject, and the reader had exhibited the qualities of his race in closely observing the small things in nature which ordinary people would pass over without notice.

On motion of Bro. Mooring, seconded by Bro. Mitchell, a vote of thanks was passed to Bro. McNaughton.

Bro. Chas. Moseley next read a paper on "Economy in the Boiler Room," which will be found elsewhere in this issue, and received a hearty vote of thanks, on motion of Bro. Pettigrew, seconded by Bro. Mackie.

The convention adjourned at 10.30 p.m.

Wednesday, 10th Aug.

On reassembling at 9.30 a.m., Bro. Dixon brought up the report of the committee on Good of the Order for discussion. With regard to the publication of the bulletin, Bro. Robertson said he had sent a copy, during the preceding four months, to every engineer whose address he could obtain, from Halifax to Vancouver, and where he could not get addresses, he addressed them to the waterworks engineer of the town or village. The question whether they should be sent to the branch associations and distributed to members from the rooms, or be sent direct to the private addresses of members, was discussed, it being the opinion of the majority that it would be better to send it to the houses of members, and each branch should have an address book in which the house addresses should be kept.

On motion of Bro. Geo. Mackie, seconded by Bro. Fox, the whole question of the bulletin was left in the hands of the committee appointed on the previous day.

On the subject of the laxity of branch associations in sending in reports of their meetings and recording their progress generally, Bro. Webb suggested that a printed form of report be sent to the various branches, on which they could report every month, and the Executive Secretary was authorized to prepare such a form.

On the clause of the report relating to the office of secretary, Bro. Dixon moved, seconded by Bro. Chapman, that the Executive Secretary be elected for a term not less than two years. In the discussion it was thought that the association lost much by having a new secretary every year, as by the time one secretary had become proficient in his work, a new man was elected, and the thread was broken. Organizations that had a capable permanent secretary showed better results. The resolution carried.

On the question of the price of stationery supplied to the branch associations, Bro. Robertson stated that the gross receipts of the year from stationery amounted to about $40, and the net profit amounted to about 25 per cent. In view of the smallness of this item it was decided, on motion of Bro. Mackie, seconded by Bro. McNaughton, to allow the present prices for stationery to stand.

The subject of the Bill brought before the Dominion Parliament, for licensing stationary engineers, was then brought up. Bro. Chapman, as one of the delegation sent to Ottawa, reported that along with Bros. Wickens, Mitchell, Ames and Simmons, he had obtained the active help of Mr Wood, the local member, and the deputation was introduced to the Minister of Justice during the last session. The Minister of Justice showed, by the B.N.A. Act, that the Dominion Parliament had no jurisdiction on this matter, and that it must be brought up in the provincial legislatures. Through the different branch associations about 50 individual members of parliament promised to vote for the Bill, but the opinion of the Minister of Justice blocked the measure, and on the advice of their friends in parliament, it was not introduced into the house.

Bro. Ryan said a number of members of Montreal No. 1 had taken a lively interest in the Bill, and got the Montreal M.P.'s to favor it. Meantime the Bill had been dropped by the Ottawa delegation, who, instead of reporting the result, had allowed Montreal No. 1 to go on working and spending time to no purpose. This was a case of downright negligence, and was the cause of a good deal of annoyance to Montreal members, who should have been informed of the failure of the delegation.

Bros. Mooring, Chapman and Dixon agreed that the deputation to Ottawa were to blame, and should have reported the result of their visit in writing; and Bro. Chapman considered that every engineer in Ontario was to blame for not working harder to secure the passage of a Provincial Engineer's License Bill.

On motion of Bro. Pettigrew, seconded by Bro. Fox, the following were appointed a committee to take up the matter again, and endeavour to secure the passage of the Bill: Bros. Dixon, Allan, Webb, McNaughton and the mover.

An invitation was here received from the Hamilton Literary and Scientific Association to visit their museum on Main street.

The Mileage Committee reported that the total of the mileage allowances paid to delegates was $179.10, leaving a surplus still in the hands of the Executive of about $100.

Bro. Pettigrew was then requested to read the following reply to the address of welcome:

"To his worship, Mayor Colquhoun and Aldermen Carscallen and Nelligan: Gentlemen—We, as a body of engineers, extend to you our hearty appreciation of your cordial and kindly address of welcome to your pleasant and prosperous city, at our ninth annual convention. We, as a body of working men, do not believe in the furtherance of strikes or labor trouble of any kind. We are organized for educational purposes, in order that our employers may be benefited thereby, and thus ensure for them efficiency, carefulness and stability to reduce operating expenses generally. It is our aim to advance the interests of those by whom we are employed. It may be interesting for you to know that there are members of this association who are worth 100 per cent. more to their employers to-day than they were ten years ago, thus showing that their admission to the society was to their benefit as well as to their employer's. It is not our intention to laud our society as being the best on earth in regard to benefits, such as insurance, sick benefits, etc., but we do maintain that our society is the best organized for the advancement of its members in their calling. We are pleased to meet in your beautiful city, and trust that our meeting here may be beneficial to you and the manufacturer and steam user, as well as to ourselves, and hope that we may meet here again some time in the future. We wish to thank you for the hearty reception you have accorded us, and we assure you that we feel entirely at home here. We shall endeavor to conduct our business in the best manner possible, and trust our deliberations may be profitable to one and all. Again thanking you for your kind and enthusiastic greeting, we are yours respectfully, Thomas Ryan, Montreal; A. M. Wickens, Toronto; W. G. Blackgrove, Toronto."

Bro. McNaughton wished to ask the president what was meant by a "member in good standing."

The president replied that it was a member who was not six months or more in arrears with his dues.

Bro. Webb said that branch associations, by paying capitation tax on its delinquent members, obtained representation at the conventions to which they were not really entitled.

Bro. Mooring said this was a burning question in Toronto, and there ought to be some uniform policy adhered to in this matter.

The president said the real trouble was that the branch associations did not take off their books members who fell in arrears without special cause.

Bro. Webb said that in Ontario all associations were under the Ontario Assessment Association Act, and must give a member due notice of his suspension. In the case of Toronto, a good many members had been notified of their arrears time and time again. Members in arrears for one term before the convention have from the second meeting in June until the end of the month as a last chance. This was sufficient opportunity, and there ought to be no representation here from dead members.

Bro. Ryan said that in Montreal no member in arrears was carried on the books of the association unless he could show cause for non-payment.

On motion of Bro. McNaughton, seconded by Bro. Allan, it was resolved that the local secretaries be instructed to enforce the by-law regarding members in arrears.

A question arose as to the numbering of the recently formed Toronto association, and Secretary Robertson said it was entered as "Toronto No. 2," at the request of the association itself. It was pointed out by some members that another branch being already known as No. 2, this would lead to confusion.

Bro. Geo. Mackie moved, seconded by Bro. McNaughton, that when the present stationery ran out, the name of Toronto No. 2 be changed to No. 18. Carried.

Bro. Dixon thought that locally the new Toronto branch could still be known as No. 2, and the No. 18 could be used in convention matters.

The convention then adjourned till afternoon, when Bros. Dixon, Asselstine, and Grundy were appointed scrutineers for the election of officers. The election resulted as follows, the first three being returned by acclamation:

President, W. F. Chapman, Brockville.
Vice-president, R. C. Pettigrew, Hamilton.
Secretary, J. G. Robertson, Montreal.
Treasurer, G. C. Mooring, Toronto.
Conductor, Wm. Bear, Dresden.
Doorkeeper, John L. Wendell, Waterloo.

Bro. Robertson moved, seconded by Bro. Dixon, that the next annual convention be held at Berlin.

Bro. Fox moved, seconded by Bro. Bain, that the next convention be held at Toronto.

Upon a show of hands the question was decided in favor of Berlin.

The installation of the new officers then took place, Bro. Ryan being appointed installing officer.

In the absence of the Mayor, Judge Snider performed the ceremony of pinning the past president's jewel on the breast of the past president, remarking as he did so, that he had heard of past president Philip's intelligence and uprightness in the discharge of his high office, and it gave him, therefore, especial pleasure in being the medium of presenting the jewel. Bro. Philip replied in suitable terms. The work of the officers was carried on under difficulties, and the only way to make it a success was for each one to do what lay in his power.

Bro. Ryan was then asked to present himself before Judge Snider, and was evidently surprised at the request. He was still more surprised when a past president's jewel was taken out of a case and pinned on his breast. Judge Snider assured Bro. Ryan that this token expressed the feeling of reverence and esteem in which the association held him for his past efficient services.

Bro. Ryan said he could hardly tell how surprised he was at this manifestation of good-will, and he could only say just now that he would persevere in his efforts to promote the good of the association.

On motion of Bro. Dixon, seconded by Bro. Mackie, a vote of thanks was passed to Judge Snider for his kindness in attending at this function; and a similar vote to Bro. Ryan for the way in which he had fulfilled his duties as installing officer.

On motion of Bro. Mooring, seconded by Bro. Mackie, a gratuity of $25 was presented to Bro. Robertson for his efficient services as secretary.

The price of the new handbook was fixed at 25 cents to members, and 50 cents to outsiders.

On motion of Bro. Dixon, seconded by Bro. Philip, a vote of thanks was passed to The Canadian Engineer for its report of the convention, and the interest it had taken in the progress of the association.

Bro. Wickens, who now arrived, being asked as to the license bill, said a circular had been sent to all members explaining the proposed Bill and , soliciting their support. About 50 promises were received, but when the deputation went before the Minister of Justice, he held that under the B.N.A. Act, the Dominion Parliament had no jurisdiction. The Marine Engineers were brought under license from the Federal Government, because they were a part of the machinery of the trade and commerce of the country, over which it had jurisdiction, but it was not so with Stationary Engineers. Hence the Minister argued that the Provincial Government only had the right to pass such a law. The Ontario Association of Stationary Engineers had put up the expenses of the deputation, to the extent of $200, and they had appropriated $150 more for prosecuting the measure in the Ontario House.

After some discussion it was decided that the committee of this association should co-operate with the committee of the Ontario Association of Stationary Engineers, with a view to obtaining the necessary legislation.

On motion of Bro. Philip, seconded by Bro. Fox, a hearty vote of thanks was passed to Hamilton No. 2, for its hospitality and the pains it had taken to make the convention a success. Bro. Ironside said that it would afford him pleasure to convey the resolution to his association.

On motion of Bro. Ryan, seconded by Bro. Fox, it was decided that the expenses of the hall be paid for out of the funds of the Executive.

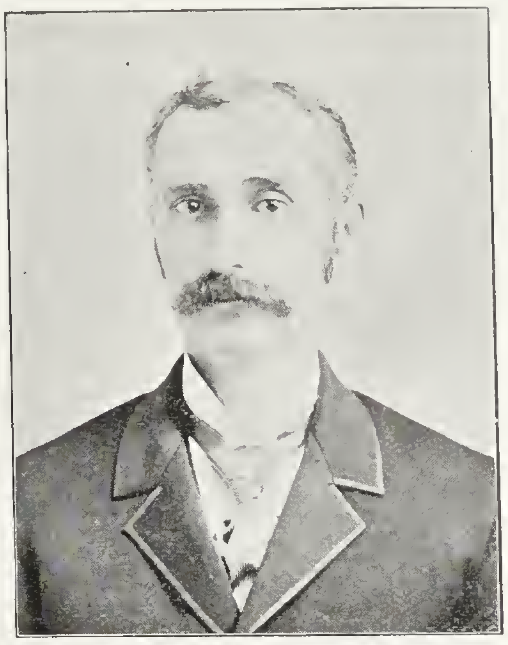
After a vote of thanks to the city press, the convention closed, and the delegates went on a trip of observation around the city, visiting the new sewage disposal works (described in The Canadian Engineer of Jan., 1897), where they were shown the various processes by Bro. Robt. Mackie, the engineer in charge; and visiting also the Victoria Yacht Club's establishment, the House of Refuge and the Street Railway power house. The delegates were presented at the City Hall with a copy of the handsomely printed "Souvenir of Hamilton," and in the evening they were the guests of the Hamilton Street Railway Co., in a ride about the city on a special car.

THE BANQUET.

The proceedings of the convention were brought to a close by a very successful banquet, given in the large dining-room of the Waldorf. This was the maiden dinner in the new hotel, and the impression made by the management was certainly very favorable. Over 100 guests sat down to the dinner, which was presided over by Robt. Mackie, president of the Hamilton branch, who made an excellent chairman. He was assisted by the following members of the Hamilton branch, who acted as dinner committee: J. Ironside, secretary; W. R. Cornish, W. Stevens, R. E. Chilman, Thos. Chubb, and Geo. Mackie.

After reading letters of regret from Mayor Colquhoun and others, who were prevented from attending, the toast list was taken up. The "Queen " was followed by "Canada our Home," to which Stuart Livingstone responded, referring to the romantic and stirring incidents that abounded in the three and a half centuries of Canadian history. He gave a glowing eulogy of the U. E. Loyalists, those heroes and heroines who left all to maintain their allegiance to the empire, who, having no houses, no villages, no post offices, no railways or telegraphs, and no newspapers to record the story of their wrongs, followed the northern star, and worked out their destiny in pain and trial, but with a never faltering loyalty. It was the thought of what these loyalists had done for Canada that nerved us to the struggle of 1812, and had inspired us to every high national endeavor since; and there was no man here who could not be thrilled with the story of brave Laura Secord, who threaded her way 20 miles through the dense woods to warn Lieut. Fitzgibbon, and enable him to capture a force of Americans of ten times his own. The speaker referred to the many Canadians who had achieved fame abroad—in India, Egypt, and other remote lands—and to the vast opportunities there were for great achievements in our own wide domains, which our fathers won by right of purchase, but which we have by right of birth. "The Mayor and Corporation " was replied to by Ald. Nelligan, and ex-Mayor Blaicher. The former regretted the absence of the Mayor, who was in Toronto attending his duties as member of the legislature. His statement that a copy of the "Souvenir of Hamilton" was being presented to each delegate was received with cheers. He concluded by hoping that in the near future the convention would come back to Hamilton. Ex-Mayor Blaicher was pleased that the convention had received a hearty welcome, and he commended them for their principle of non-interference in strikes, which had done a great deal of harm to Hamilton in days gone by. He was proud of the scenic beauties of Hamilton, and its neighboring country, so famed for its orchards and vineyards, and was equally proud of the fact that the manufactures of Hamilton now commanded the confidence of the whole Dominion, while some of its products were known and esteemed in foreign countries. "The Manufacturers " was responded to by ex-Ald. A. H. McKeown and J. H. Clappison, of the Clappison Pipe and Boiler Covering Co. Mr. McKeown said the manufacturers of Hamilton had confidence in this association, knowing that if they employed a member, they were sure to have an efficient engineer, and generally a trustworthy man. The manufacturers recognize that in this way the association has been a great benefit to themselves. Mr. Clappison expressed the pleasure it gave him to reply to this toast. Being a manufacturer himself, he was proud to realize the truth of the statement already made that Hamilton now took a leading part in the industrial development of this country. The quality of Hamilton's special manufactures was constantly rising in the estimation of the people. He was glad that the delegates were going away pleased with their reception, and he hoped when the next convention was held here, that they would come in three times their present numbers. The toast of "Educational Interests" was coupled with the name of W. H. Ballard, public school inspector; J. M. Williams and Percy Domville. Mr. Ballard said if citizens of Hamilton were proud of their advance in educational matters, they owed it to themselves. The school attendance in the city had increased 70 per cent. in the last 13 years, and the general work of the schools had doubled in the last 10 years. Over $250.000 was now invested in school property. Mr. Williams referred to the pleasure he took in being with the association, as while he may have taught them some things he had also learned from them. Mr. Domville, in his speech, advised steam engineers to learn something about electricity, which was creeping into so many lines of manufacture. In a few days they would have the electric current, generated 30 miles away, turning wheels in Hamilton. Some went so far as to say that electricity would do away with steam altogether, but he did not think this would come to pass, as there were plants that could be run more cheaply by steam even when the electric current was brought into Hamilton. "The Executive Head" was responded to by past-president E. J. Philip, who was glad to say that the Executive was in better shape this year than for some years past, and he hoped it would be in still better shape next year. He was always glad to come to Hamilton, for he thought very highly of the city and its citizens. President W. F. Chapman followed, expressing his pleasure at meeting the people and the engineers of Hamilton, who should be proud of their beautiful city. As president of the association, he hoped to follow in the footsteps of their popular past-president. Secretary J. G. Robertson and treasurer G. C. Mooring also replied, complimenting the Hamilton branch on the good work it had done. Telegrams were read from Albert E. Edkins, of Toronto, and John J. York, of Montreal, both past presidents, conveying their felicitations to the assembled guests. "Sister Associations" was responded to by J. M. Wickens, representing the Ontario Association of Stationary Engineers. He referred to the new Cataract Power Co.'s works, and pointed out that through the work of the C.A.S.E., there were plants in this city that had got the cost of steam down to such a point that the new electric power company could not displace it. Another thing the C.A.S.E. had accomplished was the institution of technical branches in the high schools of Ontario; while the establishment of the Toronto Technical School, which had shown such excellent results, was also due to it. "The Press" was replied to by E. B. Biggar, of THE CANADIAN ENGINEER, and by Messrs. Reid and Kirkpatrick, of the Spectator and Times. "The Ladies" were championed by Thomas Ryan, Montreal, J. M. Dixon, Toronto, and P. McNaughton, Montreal, and while all three spoke extremely well, it was admitted that Mr. Dixon's was the speech of the evening, and he came off with honors, both as an orator and entertainer. "The Host and Hostess" concluded the toast list, and the company broke up about 2 a.m. The musical part of the programme was well rendered by James Jardine, Geo. Allan, E. T. Martin, W. W. Barlow, J. Grant, and J. M. Dixon, B. Arthur being accompanist.

W. F. Chapman, president of the Canadian Association of Stationary Engineers, was born at Gananoque, Ont., and was in business for some time with his father, John Chapman, who operated a cheese and cheese box factory there. He picked up a knowledge of engineering in his father's factory, and having studied electricity, gained enough knowledge of that business to instal the electric plant for Cooke Bros. at Lachute. After running this plant for some time he installed a plant at the Taylor & Walton Carriage Co.'s Works, this company being also owners of the Gananoque Electric Light and Water Supply Company. He then went to Brockville, and was appointed engineer of the Canada Carriage Company, which position he has filled till the present time. That Mr. Chapman has the esteem and respect of his fellow engineers is evident by his appointment to the highest honor in the association.



W. F. CHAPMAN, PRESIDENT, C. A. S. E.

R. C. PETTIGREW, VICE-PRESIDENT, C. A. S. E.

A biographical sketch of Robert C. Pettigrew, who has been elected vice-president of the C. A. S. E., has already appeared in The Canadian Engineer. Mr. Pettigrew, who is in business as a coal merchant in Hamilton, has not only been a generous helper in all that concerns the progress of the C. A. S. E., but has for many years taken a lively interest in the municipal affairs of Hamilton. He was for three years on the School Board, and is now an alderman, representing Ward No. 7, having been returned at the top of the poll.

G. C. MOORING, EXECUTIVE TREASURER, C. A. S. E.

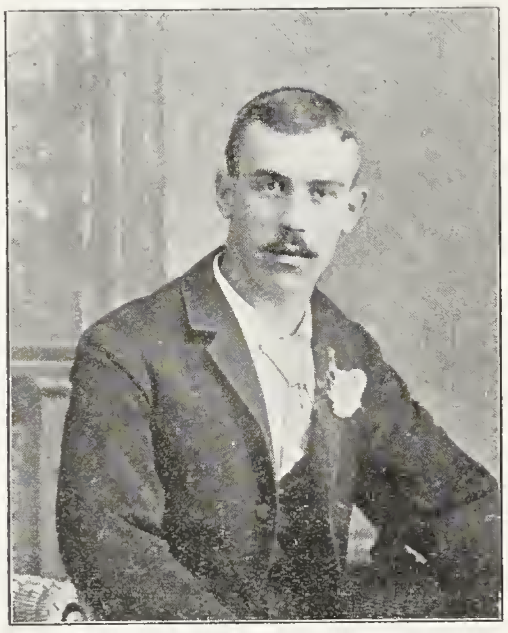
G. C. Mooring, executive treasurer of the C. A. S. E., was born at Evenly, Northampton, England, and came to Canada in 1874, when he obtained employment with Thompson & Williams, of Stratford, as machinist. Having learned the business there, he came to Toronto in 1878 working successively at the

Toronto Reaper & Mower Works, the Massey Company's Works, the Toronto Bridge Works and the Standard Woolen Mills. For the last nine years he has been in the employ of the Methodist Book Room, as engineer of their large printing and binding establishment. His father was also an engineer.

J. G. Robertson, executive secretary of the C. A. S. E., was born in St. Johns, Que., and on reaching the age at which he felt able to make his own way in the world, went to Chicago and apprenticed himself to Crane Bros., the large valve makers of that city. After living in the United States in various cities, as machinist, for about 17 years, he returned to Canada about twelve years ago and settled in Montreal. He was appointed engineer of the Montreal General Hospital, a position he has ably filled ever since.

WM. BEAR, CONDUCTOR, C. A. S. E.

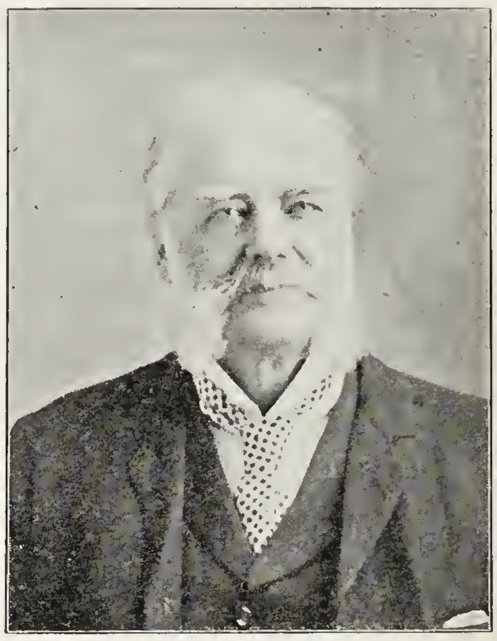
William Bear, conductor of the C. A. S. E., is a native of the State of New York, but came to Canada at the early age of 3 years, and may therefore be considered a Canadian. Mr. Bear has been fourteen years an engineer, all of which time he has served in Dresden, where he is now chief engineer of O. & W. McVeane's spoke and hub works.



JOHN L. WENDELL, DOORKEEPER, C. A. S. E.

John L. Wendell, doorkeeper of the C. A. S. E., is a native of the thriving town of Waterloo, Ont., and represented the Waterloo branch of the C. A. S. E. at this year's convention. Mr. Wendell has been about six years an engineer, and is now assistant engineer at Seagram's large distillery in Waterloo.

Thomas Ryan, engineer of the Federal Government buildings, Montreal, who was presented with the past president's jewel at the Hamilton convention of the C. A. S. E., was born in Quebec 62 years ago, and his father and mother before him were both born in the same city. Mr. Ryan served his apprenticeship as a machinist in the shops of Calvert & Tweedall, of Quebec, and after serving his time obtained his first engagement as engineer on the steamer "Blue Bonnet," running from Montreal to Cornwall. He was then less than 20 years of age and was the youngest engineer of his time on any large Canadian boat. After having charge of the engine at the dry dock works of Milln & Milne, Montreal, he was appointed engineer of a dredge under the Public Works Department. After remaining there several years, he was taken into the service of the Ottawa River Navigation Company as engineer of the steamer "Prince of Wales." After remaining with that company for 16 years he entered the service of the Quebec, Montreal & Ottawa Railway Co., now a part of the C. P. R. system. For the past 16 years he has had charge of all Federal Government buildings in Montreal, which responsible position he has filled with eminent ability. His ripe experience, good judgment and sound practical engineering knowledge have won the confidence of each successive Government. While Mr. Wickens is looked on as the founder of the Toronto branch of the C. A. S. E., Mr. Ryan may be called the father of the organization in Canada, having formed the pioneer association in Montreal about 1883. He, with George Hunt and Harry Wilson are, so far as known, the only members of the original association still remaining. In response to a circular issued by Mr. Ryan, about a dozen engineers gathered in the old Sunderland House, St. Lambert's Hill, in the year mentioned, and there formed the first Association of Stationary Engineers, the constitution being based largely on the National Association of Stationary Engineers of the United States. Mr. Ryan also took part in founding the first association of engineers for the benefit of French Canadians, who from lack of knowledge of the English language, were unable to reap the full benefit of the English Association. Mr. Ryan is a prominent member of St. George's Lodge, No. 10, A. F. & A. M., and is a past officer of the Grand Lodge of Quebec.



THOS. RYAN, PAST-PRESIDENT, C. A. S. E.

ANSWERS TO CORRESPONDENTS.

A. W. E., Lennoxville.—We have advised you privately as to the makers of acetylene lamps.—Ed. Can. Eng.

G.—In answer to your question about the fairness of the specifications upon which tenders were called for an electric lighting plant, it appears to us that the specifications of an individual make of apparatus, as the lamp for example, would naturally shut out from tendering the makers of rival appliances. —Ed. Can. Eng.

MECHANICAL STOKER TEST.

The General Engineering Co., of Toronto, Ltd., successors to the Weeks-Eldred Co., are installing six of the Jones Underfeed Mechanical Stokers in the mills of the Laurentides Pulp Co., of Grand Mere, Que.; twelve in the pulp mills of the Maritime Sulphite Fibre Co., of Chatham, N. B.; twelve in the power house of the Toronto Railway Co.; two in the new C. P. R. station at Dalhousie Square, Montreal, and a second order for the Windsor Hotel, Montreal.

A commercial test was made recently on two boilers at the power house of the Toronto Railway Co., for the purpose of determining the saving in fuel effected by the Jones Underfeed Mechanical Stoker. The boilers tested were of the cylindrical, return-tubular, internally fired type, 9 feet 9 inches diameter by 14 feet long, each boiler having two corrugated flues 39 inches inside diameter and 80 tubes 4 inches diameter, 14 feet long. The report of the test published by the company shows a saving in fuel effected by the stoker for equal evaporation of 15.2 per cent., and increased evaporation for equal fuel equal to 17.93 per cent.

THE LATE SIR CASIMIR GZOWSKI.

SIR CASIMIR GZOWSKI.

Col. Sir Casimir Gzowski, A. D. C. to the Queen, died at his residence, "The Hall," Bathurst street, Toronto, Aug. 24th.

Casimir Stanislaus Gzowski was descended from an ancient Polish family, who in the 16th century were ennobled, and who for a period of 200 years after their elevation continued to exercise great political influence in Poland. The father of Col. Gzowski was known in Poland as Stanislaus, Count Gzowski, and held a commission in the Russian National Guard. Sir Casimir was born in St. Petersburg, Russia, in 1813. At a very early age he entered the military college at Kremenetz, Province of Volhynia, where he pursued a course of military engineering, and in 1830, having been in the college eight years, he graduated as an engineer, and was awarded a commission in the Russian army. It was at the time of his first entering the Imperial army that one of the periodical insurrections occurred arising from the discontent of the Polish people at the severe treatment of Constantine, brother of Emperor Nicholas, who was made military governor of Poland. An organized revolution finally broke out, in which most of the Polish officers in the Imperial army joined. This revolution culminated in the expulsion of Constantine, who, with his court and Russian adherents, were driven from Warsaw. Young Gzowski, who had just received his commission at the time of the first outbreak of the insurrection, immediately joined his compatriots, and played a conspicuous part throughout the insurrection, and was present in Warsaw in November, 1830, when the Grand Duke Constantine was expelled.

As is well known, Russia and Austria, after bloody conflicts, lent their assistance to quell the insurrection, and Warsaw was recaptured from the Poles by the allied forces under Count Paskevitch in 1831. The prisoners taken at Warsaw on its fall were either condemned to die or to linger in the mines of Siberia. After the battle of Baremel, Gen. Devernicki's division, to which Gzowski was attached, retreated to Austrian territory, and the division surrendered. All but the officers were allowed to go wherever they pleased, but the officers were condemned to military prisons for some months, when an arrangement was entered into between Austria and Russia, and the whole of them were shipped to the United States, Colonel Gzowski among them. Colonel Gzowski landed with his fellow exiles in the United States without a penny. He found that owing to his lack of knowledge of English his engineering skill would not be very remunerative, so he set to work to learn the language, and for a time taught French and German in New York. Subsequently he articled himself to Parker L. Hall, a lawyer of Pittsfield, Mass., and studied law. During these studies he maintained himself by giving lessons in modern languages, drawing, and fencing, in the local academies. In 1837 he began the practise of law in Beaver county, Pa., and remained there until 1841. From 1841 to 1846 Mr. Gzowski was employed in the Public Works Department of the Canadian Government. In private practice after leaving the employ of the Government, the first great enterprise with which Mr. Gzowski was connected was the St. Lawrence and Atlantic Railway Company, from Montreal to Island Pond. He was appointed chief engineer, and was practically engaged on the construction of this railway. This appointment he resigned when the railway became merged in the Grand Trunk Railway. Subsequently a partnership was formed, the firm consisting of Sir Alexander Galt; the late Luther H. Holton; the Hon. D. L. Macpherson, and C. S. Gzowski. This firm on the 24th of March, 1853, obtained the contract for the construction of a line of railway from Toronto to Sarnia. The work was attended with enormous profit, and was satisfactorily completed. Among other railway works completed by the firm of Gzowski & Macpherson is the line from Port Huron to Detroit, and from London to St. Mary's, in the Province of Ontario. One of the most noteworthy and successful feats of engineering performed by the firm of Gzowski & Macpherson was the building of the International bridge over the Niagara river, at Buffalo. The charters for the construction of this bridge were granted by the Legislature of Canada and State of New York in 1857. The funds for its completion were raised in England in 1870, and the bridge was completed November 3, 1873, the cost of construction amounting to over $1,500,000. He was the chairman of the Queen Victoria Niagara Falls Park Commission.

Sir Casimir was connected with many financial concerns during his long career. He was at various times president of the Toronto Club, for some years president of the London and Canada Loan and Savings Company, president of the corporation of Wycliffe College, and vice-president of the Ontario Bank. He was appointed lieutenant-colonel of the Central Division of Volunteers in Toronto, in 1873. His last and highest promotion was that of full colonel, and in May, 1879, he was appointed aide-de-camp to her Majesty Queen Victoria, being knighted K. C. M. G. a year later.

F. NAPIER DENISON.

F. Napier Denison was educated at Upper Canada College and entered the Toronto observatory, but finding promotion slow, went to Boston and studied electrical engineering. After obtaining a certificate he traveled for six months throughout the United States as electrical expert for the Thomson-Houston Electrical Company. In 1891 he came to Canada and joined the Excelsior Company. During 1892 he spent six months traveling throughout the various countries of Europe, where he obtained much valuable electrical information as well as attending special lectures in London. During 1893 he perfected his electric dental engine, which has been patented in many countries, and is being successfully manufactured in Canada, not only for a large home, but also British, trade. This was followed by many others (all patented), including an electric transmitting thermometer, an electric brake, a new grain bin and heat detector, a combined shaving brush and soap holder for travelers. After re-entering the meteorological service in 1895 he devoted his inventive ability to the benefit of this service, and has devised an electric anemograph or automatic instrument to record both the direction and velocity of the wind, a simple form of "hydrograph," set up at the mouth of the Humber River to record the lake undulation; and as it was thought these undulations were due to atmospheric waves, he devised a self-recording barometer seventeen times as sensitive as the ordinary mercurial type,

F. NAPIER DENISON.

which was set up at the Toronto observatory. By studying corresponding records from both instruments, the direct action of atmospheric waves as causing the water undulations was clearly shown. In July, 1897, Mr. Denison devised a combined instrument to record both lake and atmospheric undulations upon the same time cylinder, and set it up in place of the former instrument. This device, which has been termed a "hydro-aerograph," was fully described in a paper read before the Toronto meeting of the British association last year by the inventor, a reprint of which appeared in the October and November numbers of this paper. Last May Mr. Denison constructed for the Public Works Department, Ottawa, another form of hydrograph, which has been set up at the Queen's wharf, Toronto. Mr. Denison has left Toronto for Victoria, where he is to start weather forecasting for the Province of British Columbia, issued in the same manner as those from the central office, Toronto. A sensitive hydro-aerograph is to be installed there, as it is hoped the records from some will tend to assist in warning the approach of storms, which sweep in off the Pacific Ocean.

FIRES FOR THE MONTH.

Aug. 3rd The Canadian Rolling Mills, Peck, Benny & Co., Montreal; damages amounted to $75,000; insurance, $152,000.——Aug. 4th. J. & B. Grier, saw mill, Montreal; loss about $10,000.——Aug. 4th. St. Lawrence Portland Cement Co., Montreal; premises destroyed; loss, $20,000; small insurance.——Aug. 5th. Devine Bros., Killaloe Station, Ont., planing mill; loss, $1,000.——Aug. 9th. Victoria, B. C., Chemical Works; partially destroyed; loss about $20,000; fully insured.——Aug. 13th. Jenckes Machine Co., Sherbrooke, Que.; damaged to a considerable extent but covered by insurance; business has not been interrupted materially.——Aug. 14th. M. Bristol's wood-working factory, Madoc, Ont.; loss, $10,000; insurance, $1,000.——Aug. 14th. Biette & Co.'s saw mill and cheese-box factory, Chesley, Ont.; loss, $8,000; insurance, $1,000.——Aug. 14th. Miller Bros.' paper mills, Glen Miller, Ont.; damaged to extent of $17,000; covered by insurance.——Aug. 22nd. Steamer "Golden City" burned at her docks, Lakefield, Ont.; loss, $5,000; some insurance.——Aug. 26th. J. H. Still's handle factory and unused pipe foundry adjoining, St. Thomas, Ont.; loss, $50,000 on the handle factory, and $10,000 on the foundry.——Aug. 28th. The Parmenter & Bullock Co.'s rivet and nail works, Gananoque, Ont.; loss, $30,000; insurance, $12,000.——Aug. 30th. Some damage was done to the power-house of the London (Ont.), General Electric Co., amounting to about $1,000.——Sept. 1st. Bertram Engine Works Co.'s shipyard, Toronto, damaged to extent of $60,000; fully covered by insurance.

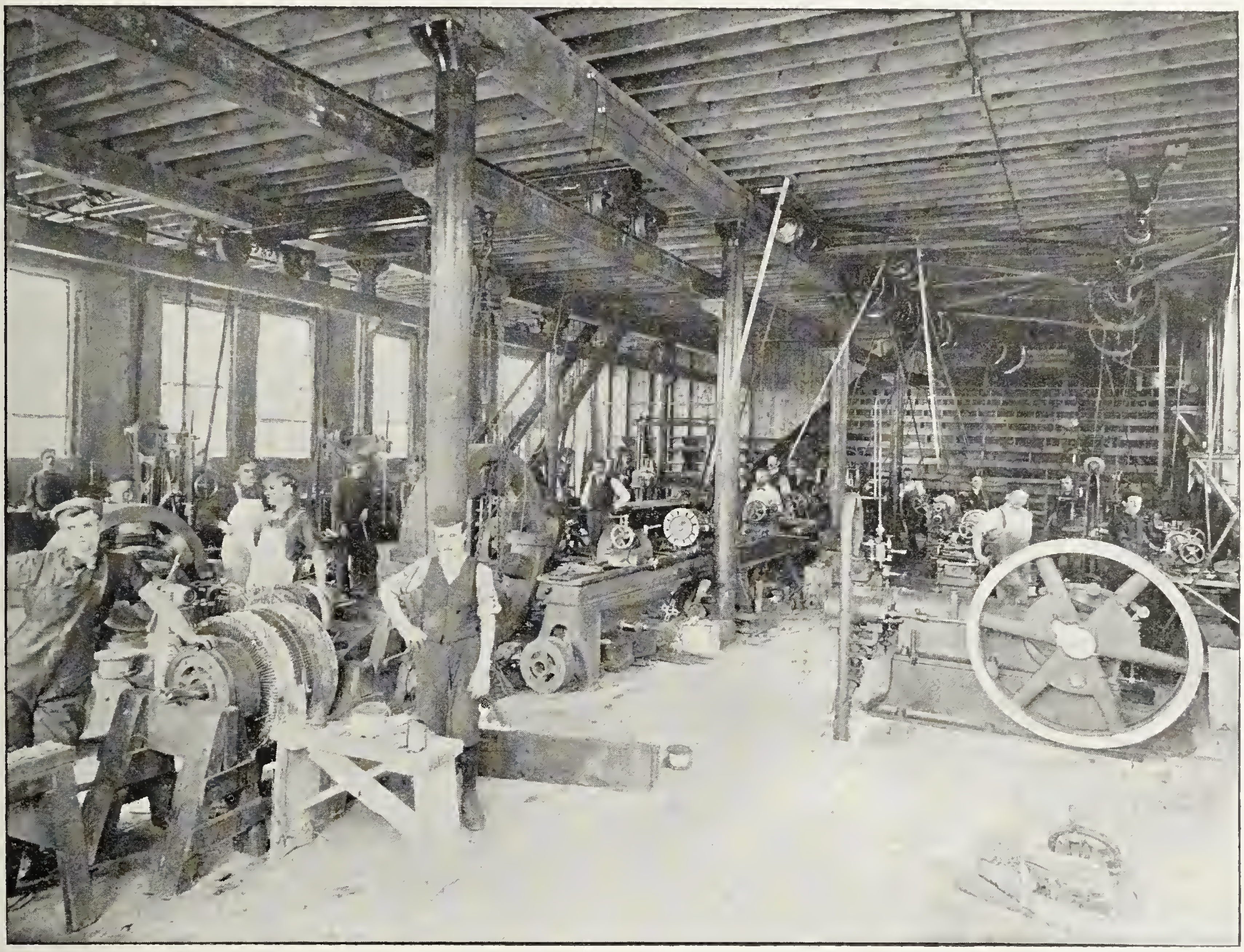
THE TORONTO ELECTRIC MOTOR COMPANY, LTD.

In this issue we present a cut of The Toronto Electric Company's new factory recently completed and now occupied by this thriving manufacturing concern, which started business some six years ago, and which has steadily increased year by year, until now it is one of the leading firms in Canada in the manufacture of the electric machinery and apparatus for lighting and development of power in all its branches. Beginning with electric motors in a comparatively small way the company has added new lines from time to time as demands required, such as belted C. P. dynamos and direct connected generators for lighting and power service in all standard sizes up to 300 k.w.

THE TORONTO ELECTRIC MOTOR CO LIMITED.
THE TORONTO ELECTRIC MOTOR CO LIMITED
MAKERS OF ELECTRIC LIGHT & POWER APPARATUS.
Tor. Eng. Co.

In March this year this company amalgamated with the Thompson Electric Company, Hamilton, Ont., thus adding that firm's well-known system of automatic arc lighting dynamos and their several types of arc lamps for constant potential, constant current and alternating current circuits, together with all their machinery and special tools for manufacturing. This company's new works are of the most modern and improved type for the class of work upon which it is engaged. The machine shop is supplied with the latest improved machinery and tools, classified and divided into sections, to best suit the convenience in handling the different classes of work; each section being operated by an independent electric motor. The centre of the shop is provided with a 16-ton traveling crane, for its entire length. The arc lamp department is on the second floor, and is supplied with light machinery and special tools and jigs for turning out accurate and standard work. Then comes the winding room, which is also a separate department, and supplied with necessary lathes, forms, bucks and special appliances for this particular class of work. In the basement is situated the brass moulding department and steam plant, which operates a direct connected unit that supplies current for the power and lighting of the entire works.

The company is now working its factory overtime to meet the demand for its apparatus. Some of the principal orders now being turned out are: Direct connected generators for the T. Eaton Company; complete electric plant for the Verity Plow Company, Brantford, Ont., including a direct connected generator; two incandescent dynamos for the Parkhill Electric Light Company; two 60-light arc dynamos and 80 arc lamps for the Brantford Electric & Operating Company; electric power and lighting plant for the Rat Portage Lumber Company; two 40-h.p. motors for The Mail and Empire Company, 100 arc lamps for the Lachine Rapids Hydraulic & Land Company, Montreal, and numerous smaller orders. Owing to the pressure of business this company will not exhibit at the Toronto Industrial Exhibition this year. Any visitor that will favor the company with a call at the new works, 39 to 45 Pearl street, will be warmly welcomed.



TORONTO ELECTRIC MOTOR CO.'S MACHINE SHOP.

AN UNSANITARY DISCOVERY.

BY W. M. WATSON.

Tourists spending their holidays in Muskoka and other Ontario summer resorts have been considerably exercised on account of offensive odors that have, during the present excursion season, pervaded those districts. We have it on unquestionable authority that large gatherings have abruptly dispersed on account of a sudden passage through the air of a disgusting odor, and which has been stated to be caused by a pest named a stink bug. In the early days of my residence in Canada I was a thorough unbeliever in the power of the animal called a skunk to create a nuisance, but in time proofs came to hand and I was convinced. But not so with the theory put forth to explain the odors that have occasionally contaminated the air, and entered the interior of several of the hotel rooms; before such statements can be taken for granted, at least one of the pests must be caught and produced. I have been engaged to try to give a reliable reason for the foul odors that seem to come, sometimes rather suddenly in the evenings at one of the hotels, and after about 30 minutes time (often less), it completely passes away. It seems only to come after sunset and seldom after the hours of midnight. This almost proves that the cause of the odor either moves in the atmosphere like a bird or the odor is in such large quantities that it moves through the atmosphere in a column, leaving the odor in any place or in any room that it may come in contact with during its passage.

From the information I have gathered I find that there are hotels in that district whose sanitary conditions could be improved, and others that have secured the city advantages of a plentiful supply of good water and almost every modern sanitary appliance necessary for the cleanliness and comfort of their patrons, erected with great care, and high class workmanship. It is one of the last named kind that I was called upon to inspect and try to locate the cause of the occasional unpleasant odors. I was the third party that had been called in for the purpose. Each of the previous firms had thoroughly examined and tested the plumbing appliances and drains, and I believe found them smoke-proof and perfect. This hotel had a private sewage disposal works, that seemed to get all the blame, from the managers and attendants. The settling tank was 100 yards from the house, and well covered up, with an air-tight wooden cover, and sand. It had a breather pipe about one foot high and a 4 inch air discharging pipe, 20 feet high, and on account of a suspicion that the foul gases from the tank were discharged into the air through the two pipes, and traveled into the rooms of the house, they had been plugged tight up, but the smell still continued to come as usual. Then the irrigation gravel sewage filter was over another 100 yards away, situated behind a bend and cliff of land, which had also two tall air vent pipes, which would discharge foul air that might travel to the hotel, but it appeared to me rather improbable.

The boarding accommodation for tourists is erected on low grounds near the sheets of water, and this one had high hills on two sides acting as a boundary line and shield of the narrow strip of water and foreshore situated between them. The sun during the day heated the surface of the land and the walls of the building, the roofs, and to a certain extent, the face of the water. At sunset the atmosphere cooled quicker than the earth, the walls and roof of the building or the face of the sheet of water. This would cause a depression of the atmosphere, making the upper strata of the air descend and cool the warm places, having the effect of reducing the draughts of chimneys, air and soil pipes, and would also let free and distribute any confined gases that might be accumulated in the sanitary apparatus or foul spots near the dwelling. This depression cannot be avoided, therefore it is the duty of plumbers and sanitarians to so erect and put togethei sanitary appliances in a way that it is absolutely impossible for poisonous gases to generate, and this can be easily done by using reasonable judgment in arranging the soil pipes, the waste water pipes, and the system of drainage.

In another article which I had written before going to inspect this place, and which is published in another part of this paper, entitled "Sanitary excesses," I have described what is needed to aerate soil and waste pipes. In April, 1897, this paper published an article of mine on sanitary appliances, which also explains how to make sanitary waste and soil pipes safe, and what is particularly necessary to be adopted in summer hotels to prevent gases and foul smells from generating in hot weather. On this account these points need not be repeated here.

The hotel of which I am writing has three separate and distinct stacks of soil pipes and sanitary apparatus in each of the three wings of the house. All the soil pipes are joined together and connected with the main trunk drain at one point. The small waste pipes from the baths, the basins, the slop sinks, and even the drinking fountains placed in the corridors of the house, are I believe each and all connected directly with the nearest line of soil pipes, and on this account none of the pipes can secure the proper amount of aeration necessary to prevent the generation of poisonous gases, and when poisonous gases are created they will in spite of every endeavoi made to prevent them, escape and contaminate the atmosphere. This statement was fully proved by the exhaustive experiments made by the city of Cologne, see report on page 62 of the July issue of The Canadian Engineer. Now it is easy to fix a first-class sanitary water closet that cannot possibly require a vent or back air pipe. And experiments prove that back air pipes obstruct soil pipe ventilation, and prevent the ventilation which is necessary to keep the interior of the waste pipes clean and properly purified. No small waste pipes serving water fountains, pipes from ice boxes, underground land tiles, or from small baths, wash basins, wash tubs or slop sinks should ever be connected directly to soil pipes or drains, because the small 1½ inch traps are easily dried out by evaporation in hot weather, and all the sooner when a back air pipe is attached, and if they happen to be dried out when a depression of the atmosphere occurs, then the foul gases will enter the rooms in large quantities. And each and all small waste pipes and fittings can be served and made absolutely safe by an easier and cheaper method. Moreover when there is a decided depression of the atmosphere, the vent pipes cannot prevent the water seals in the small traps from oscillation, and when the water in the seals oscillates it usually wastes a portion of the water over the bends, and of course the seal is broken and a passage of air created. It is just possible that the foul odors that invade the apartments immediately after sunset may be accounted for in this way, but it can be proved only by having the smoke machine attached ready and applied at once, when the foul odor is first apparent.

The plumbing of a large summer hotel requiring several sets of apparatus and stacks of soil pipes cannot be made sanitary by exactly the same methods as a place with only one set of appliances, and soil pipe, and they require much more skill and judgment to insure a thorough upward draught and free ventilation through every waste pipe, which is necessary, to remove any risk of down draught currents.

The contract for the seating of Her Majesty's theatre, Guy street, Montreal, has been awarded to the Canadian Office and School Furniture Co., Preston, Ont.

ECONOMY IN THE BOILER ROOM.*

BY CHAS. MOSELEY, ENGINEER, TORONTO INCANDESCENT LIGHT CO.

The fuel expense is one of the largest in the operation of the majority of plants, and any reduction which can be made in the amount of fuel used, while maintaining the same amount of power, is considered a direct gain. The evaporation of more than nine pounds of water per pound of coal is looked upon with suspicion by many, as it is not thought possible to obtain more than this amount in even the best designed and well regulated furnaces and boilers, especially when the firing is done by hand. Mechanically fed boiler furnaces usually give the most economical results. The actual value of the fuel depends upon the way in which it is used fully as much as on any other factor. The heat unit in the coal should be as much as possible utilized, as in one pound of good steam coal there is about 14,000 B.T.U., and about 10,000 of this amount can be utilized, so that 4,000 heat units are lost. The mixture of gases in a furnace depends on the amount of air used. One pound of coal requires theoretically about twelve pounds of air to burn completely. But in practice about twice this amount is required in the boiler furnace. To cause good combustion coal requires a good draft. The gases are consumed near the fire, and the waste gases carry the heat to the boiler on their way to the stack. The boiler ought to have sufficient heating surface, or the hot wasted gases ought to travel a sufficient distance to be cooled down to about 350° F., which temperature is found high enough to produce a good draft in a stack of at least 100 feet high. It is not necessary for me to state the need of keeping the combustion chambers free from the ash that is carried over with the gases to the chambers. In "Smokeless Heating," as published by the General Engineering Co., there is a paragraph entitled, "Competitive vs. Ordinary Test," which is well worth consideration, and I think we might study it with profit. In nearly all plants where a large quantity of coal is burned per day it is a general rule to employ the least possible number of firemen, and it keeps them very busy going from one boiler to the other shoveling in coal the whole time. It becomes more of the nature of slavery than anything else. Is there economy in this way of working ? Let us see. In making evaporation tests my experience has been that there is a large difference between ordinary working and working for short spells, as in making competitive tests. When we were making the tests in our plant, while experimenting with shaking grates, the Hawley Down Draft, and the Jones Underfeed, we did so in many different ways. With the Hawley Down Draft in one particular case we fired that boiler as would have to be done in ordinary practice, and the result was certainly a far different one from that obtained when the man stood by this furnace, and attended to it alone. If we treat the fireman as being a naturally lazy animal, I think we will be on the safe side, and you can rest assured that if he has one boiler that will do the same work as another with half the labor, even though the other takes less coal, this boiler will get the most work, and the boiler that should receive constant attention will get very little consideration from him. Between competitive and ordinary working on a hand fired boiler there is actually a difference of 10 per cent. This I have proved repeatedly, and in many cases it has run up as high as 12 per cent. What does this mean ? Does it mean that it would pay to have a man at each boiler, and simply attend to it alone ? No. It does not; for the simple reason that the less a man has to do the less he is inclined to do, and this applies more to firemen than to any one else. I might state that when we were testing the Jones Stoker we had long periods where we had competitive tests, and others again when we run as in ordinary practice: that is to say, the firemen doing just precisely as he would do if no test was being made. The coal and water, however, were measured in each case. The results were simply astonishing. In the ordinary running test the Jones Stoker would do about 50 per cent. more work and nearly 25 per cent. better economy, whereas with the competitive test the work done on the stoker was about 25 per cent. more, and 15 per cent. increased economy, which bears out the statement that between competitive and ordinary running we have a difference of 10 per cent. Now which is the correct way to look at this matter ? Can we obtain results right along with hand firing equivalent to those obtained during a competitive test? I do not think so, because firemen, as a rule, do not like to be beaten, and will do their very best during a competitive test to do up the other fellow; but at the same time he is wishing inwardly that the test was over so as to get back the old "style" again.

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*A paper read before the Canadian Association of Stationary Engineers.

There are many plants in Canada where very good results are obtained if we take the results as made by the engineers into consideration, several of them showing a usual 14 lbs. evaporation per lb. of coal. This you will readily understand is out of the question. There are also a large number where very poor results are obtained, and these poor results are due to several causes, namely: Boilers in very bad order, dirty tubes, poor setting, poor boilers, poor firemen, etc. The man who sells boiler compounds will in all probability say that you do not use enough of his compound; your answer to that is, of course, that there are compounds on the market that are absolutely of no use whatever, and it is simply throwing money away to buy it. I myself believe in a good compound, but will admit that it is difficult to get it. You may get one barrel (the first from a new maker), fairly good, the second of no use whatever, and so on it goes. A good compound is required, and to my mind to-day we have not such a thing. All compound makers state in their advertisements to send on a sample of your water, and they will give you the very compound you require after analysis. You, of course, know what this means—that if one brand does not work they will send another brand of practically the same stuff with another name and try it. Poor boiler and poor setting; this is attributed to trying to keep down the first cost. Pay a good figure for a good boiler and have it set by competent men. Poor fireman; this is in my humble judgment the most important item, and one that should receive much consideration. The fireman may not be poor, but the work that he has to attend to, namely, firing too many boilers, makes him feel that he is neither more or less than a laborer, and as long as he keeps the steam pressure up, no matter how much coal he burns, or how he does it, there appears to be little or no attention paid to him. There are many places where the fireman is never thought of except when the steam pressure goes down, and when such is the case the usual deputation calls upon him to ascertain if he is asleep or not. A good fireman is really a skilled workman, and should be treated as such. He should receive a fair salary, and his employer should bear in mind that any reduction in his pay is far from being a saving. If he is cut down $2 per week you will in all probability find your coal bill increased about $8, and there is not much economy there. How are we to obtain better results in our boiler rooms? I think by putting in machines to do the work, and having men simply to look after them.

EVAPORATION AND THE RAISING OF STEAM IN BOILERS.*

BY P. MACNAUGHTON, MONTREAL.

From the title of this paper you will notice that it is to deal with two things. First, evaporation, and second, the making of steam in boilers. These two actions are often considered as if they were distinctly different, but, I think, it can be shown that the actions are the same in the end, and that they differ only in the way in which the end is reached. In the following remarks it will be noticed that I have tried to show how the natural action of evaporation resembles the action of making steam for power, because it is always instructive to think out how the processes which we make use of every day, compare with corresponding ones in nature. Some have said that it is wasting time thinking of things in this way; if they really think so it would be wasted time, but to others it would be very instructive and pleasurable. I might say that such thoughts would be to them as salt, which though of little use in itself as a food, still makes our food more palatable. Strictly speaking the term evaporation is used to denote nature's method of changing water into vapor, and making steam in boilers is part of man's method of changing water into vapor through an intermediate state familiar to all of us called steam.

The principal actions in nature in which evaporation plays a part, have been noticed by all of us. They are the disappearing of the dew from the grass on a summer morning, and the frost later in the season; the disappearing of water when left standing in open vessels, and on a much larger scale the raising of water from our rivers, lakes and surrounding ocean. Now it is usually admitted that for every action there is a cause, and the cause of evaporation in nature is the heat of the sun. It will make our problem much simpler if we consider, for instance, a bucket of water as made up of a great number of particles of water. That this is the real state of water will be seen at once if we remember that when heat is applied to water it forms steam, which is particles of water visible to the eye, and if heat be applied to steam the particles of steam are divided into smaller particles called vapor, which is invisible.

Atmospheric air, among other things, contains a certain amount of water vapor, and this water vapor as long as the sun is shining is kept suspended uniformly through the atmosphere by the sun's heat. When the sun has set and its heat no longer acts on the atmosphere this water vapor tends to condense to a slight extent and with this condensation it becomes slightly heavier than the other components of the air, and so tends to sink towards the earth, so that in a calm, clear night in summer that part of the atmosphere lying next to the earth contains more moisture than that which is higher up.

That the above statement points out the true state of the atmosphere at night is proven by noticing the land fogs. If we go up a mountain at the first of daylight on a calm, foggy morning we will notice that as we ascend the fog becomes less dense until when we have gone up about four hundred or six hundred feet we will be out of the fog altogether.

This layer of moist air coming in contact with the cool leaves of trees, plants and other vegetation, the water vapor which it contains is further condensed, thus forming dew. I wish it to be clearly understood at this point that the collecting of dew on the leaves of plants is owing to condensation and not to a falling of water as rain. The fact that dew only gathers on the top side of the leaf, and does not collect in our houses even if all the doors and windows are open, is owing to another action which has no bearing on the subject in hand.

Now we come to evaporation or the disappearing of the dew. We have the air in two layers, the moist one lying nearer the earth and the dry one higher up. The sun rising in the sky begins to send his rays of heat earthward, the layer of air lying next the earth becomes warmed first, and owing to the principle that warm air rises, it rises, and the cooler air comes down to take its place next the earth. The air which is now next the earth is dry or lacking in water vopor, so the lack is made up by absorbing a certain amount of water in a state of vapor from the dew on the plants. This circulation has not continued long before all the dew is evaporated. This process of evaporation in nature does not cease when the dew has disappeared, but goes on continually, because there is always a demand for more water-vapor in the air on account of it being partially condensed in the upper regions of air, thus forming first, clouds, and if condensed further the clouds form rain or snow.

We will now proceed to discuss the making of steam in boilers, and then its change from steam to water-vapor, after which we will compare it with the process described above. For purposes of comparison we will turn water into steam in a boiler open to the atmosphere, that is to say, we will raise steam under a pressure of 14.7 lbs. per square inch. In this we are under the same condition as the dew which was turned into vapor under atmospheric pressure also. We will suppose that the boiler which we are going to use is a small circular vessel, say 6 inches in diameter and 12 inches deep, which may be set over a stove hole, and supplied with a steam tight cover somewhat like a piston, by using which we may vary the pressure. We will now put some water in the boiler and place it over the fire, the cover being left off. Now, remembering that water is made up of particles held together by a force (in this case 14.7 lbs. per square inch, or whatever the barometer may read), which must be overcome before we can have steam, we are called upon to exert a force in opposition to the force holding the particles together. We do this by lighting a fire under the boiler. As the fire burns a certain amount of the energy of the coal is transferred to the water, causing the temperature to rise until, when it has reached about 212° F., the coal has transferred enough of its energy to the water to enable it to overcome the atmospheric pressure and water pressure, and steam is given off. Now, we have water in a state of steam, which is visible to the eye. If we watch the cloud of steam as it rises upward, it will be noticed that it gradually gets thinner and thinner, until at last it disappears from view. What has become of it? We have produced the invisible water-vapor, and it has been absorbed by the air.

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*A paper read before the Canadian Association of Stationary Engineers.

The change from steam to vapor took place like this. In a boiler it is the water which lies next the surface exposed to the fire that is first turned into steam. In order to do this the coal must transfer energy to the water to raise not only the atmospheric pressure, but also the pressure due to the depth of water in the boiler. Now when the particles of steam emerge from the surface of the water they are under a less pressure than when at bottom of the boiler, and so contain more heat than is necessary to keep them as steam. This surplus heat or energy causes an expansion or bursting of steam into the smaller particles, which constitutes water-vapor, which is absorbed by the atmosphere.

This last expansion is on the same principle as when we open a try cock below the water line on a working boiler, it is not water which blows out but steam or vapor. We will now sum up these two operations. In the first the heat or energy of the sun does work on the atmosphere, thus setting the air in circulation, and as a result of the air circulating water is absorbed. In the second the heat or energy of the coal does work on the atmosphere, setting free the steam, and at the same time storing in the particles steam and energy, which turns the steam into vapor when it rises into the air. From the above conclusions we see that evaporation, or nature's method of making water-vapor, and the making of steam at atmospheric pressure and its change into vapor, differ only in the two forces that produce them.

In reference to making steam in boilers there are two interesting cases besides the one which we have just discussed, namely, making steam under a pressure greater than the atmospheric pressure, and under a pressure less than the atmospheric pressure. Dealing with the first mentioned case, that is, where the pressure is greater than the atmospheric pressure; this condition can be brought about by fitting the steam-tight cover on the boiler mentioned in the first case and putting some weights on it to the amount of 5 lbs. per square inch. Now, instead of steam being given off when the water is at about 212° F., it will not be given off before the temperature is 226° F. This increase in temperature is due to the fact that before steam can form in this case the coal must transmit to the water enough of its energy to raise 19.7 lbs. per square inch instead of 14.7 as before. This condition of things comes about naturally when boiling water in mines, for as we descend into the earth the atmospheric pressure increases, which corresponds to the added weight.

Lastly and briefly we will consider the making of steam under a pressure less than the atmosphere at sea level. For this we would have to exhaust the air from our boiler by an air pump or other means. Then we would find that steam would be given off when the water is at a temperature less than 212° F., according to the amount by which the pressure in the boiler is less than atmospheric pressure. This shows that as there is less pressure keeping the parts together in this case than in the other two it therefore requires less energy to set the steam free. As an example of this in nature it has been noticed by travelers going up mountains that when they got high up it takes a much longer time to boil eggs than on the plain below, although the water in giving off steam went through the same action in both places. This was due to the fact that at the top of the mountain the pressure of the atmosphere was less than at the bottom, and the water though giving off steam did not contain the heat necessary to boil the eggs. I think if these travelers had been engineers they would have piled some stones on the lid of their kettle in order to save time.

In this case it is interesting to notice that although it requires less heat to raise steam at a high elevation than at the ordinary atmospheric pressure at the sea level we do not gain anything by reducing the pressure, because when we sum up the heat required to raise the steam, and the force required to reduce the pressure below the atmosphere, we will find that it will amount to the same thing as if we were making steam at atmospheric pressure.

OILS FOR THE ENGINE ROOM.*

BY JULIUS M. WILLIAMS, CHEMIST, HAMILTON.

This subject is considered as being important enough to justify considerable attention from engineers, and this paper being much appreciated by the local association, it is by their request read before the convention, and it being considered inconvenient to repeat the full text, it is condensed, and samples of oils and the products of their decomposition are for the same reason not shown. The matter is treated in the following divisions:

1. Relation to the machine, the prime object of oil is to reduce friction, consequent to the effort of the motive force to overcome the resistance of the weight, that is the work of the machine.

2. Nature of the material, fluid, capable of passing between tight fitting surfaces either voluntarily or by mechanical means, non-resisting, especially free from abrading particles, and from corrosive qualities.

3. Possessing sufficient viscosity and specific gravity to be of service; absence of viscosity and low specific gravity being in inverse relation to the strain or weight on the bearings.

4. Nature of the machine and its special conditions.—The points of friction usually called bearings, consisting of two close fitting surfaces, one or both moving, either rapidly or slowly.

The conditions being mainly that of temperature, this suggests the division of bearings into two kinds, hot and cold; cold bearings being considered first as being the earliest in use and embracing the largest number, these are exposed to a range of temperature extending from the average of 100° F. at the top of a room to that of winter weather outside; mechanical contrivances dispose of many of the difficulties met with on account of variations due to temperature.

Hot bearings are few and include cylinders, pistons and cut-offs.

5. The requirements or qualities of the oils to meet these conditions:—

They should be clean, free from abrading substances.

Non-resistant, free from resinous constituents.

Non-volatile, permanent, so that bearings will not "go dry."

Non-drying, free from "gumming" propensities.

Neutral, free from organic or mineral acids, the first due to rancidity, the second to the refining processes.

6. Hot bearings.—To meet the conditions of the very high temperatures of the principal hot bearing, the cylinder oils require to be of high stability and especially free from the substances before mentioned, that is, volatile, resinous, and decomposable ones, owing to the fact that fixed oils decompose at 600° F.; in the presence of steam with the production of fatty acids and glycerine it is evident that oils partly decomposed, rancid, are not desirable in a cylinder.

7. The constitutional nature of oils.—They are supplied by the three kingdoms, animal, vegetable and mineral.

The animal oils are of great variety and from many sources, the principal ones being the meat and fish trades; these include the various refuse handling sections of those trades, whence are supplied vast quantities of oil.

There may be enumerated here in the order in which they predominate the animals whose oils we use in this country: The hog, horse and cattle; of the fish, cod, whale, sperm whale, etc.

The vegetable oils will be familiar as olive, castor, cottonseed, earthnut (peanut), and are variously the product of seeds, nuts, fruit.

The mineral oils constitute by far the greatest part of the oils in use as lubricants, and are used alone or in combination with oils from the other two sources. Mineral oils possess in their wide range of varieties all the requisite qualities of good lubricants.

FOR THE FIRST PLACE IN AMERICA.

I enclose herewith $1, my subscription for this year, and I am glad to notice the almost monthly improvement in the paper, and congratulate you heartily on the success of your venture. I would like to see The Canadian Engineer competing with The Scientific American for the first place in America.

Yours sincerely, E. ROCHESTER.

54 Rochester street, Ottawa, Aug. 16, 1898.

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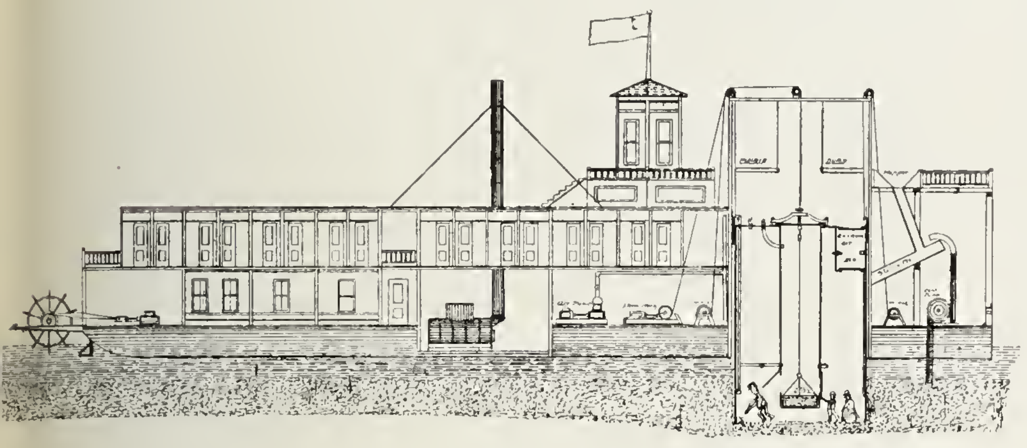
*A paper read before the C.A.S.E.

A NEW GOLD DREDGE.

A number of tests have been made at Vancouver, B. C., recently, of the model of the pneumatic caisson and air lock elevator, invented by Garrison & Wood, and which has been built by them for test purposes there. In every case the tests have proved the invention to be most valuable for the recovering of gold from the bars and beds of rivers and creeks. The model of the caisson and elevator are built into a scow for temporary purposes, but the permanent machine is to be placed on a sternwheel steamer. The model itself has a caisson 5 feet by 8 feet, but the complete machine will be built of steel, and the caisson will be 10 feet by 20 feet, so as to allow six men to be at work at one time. Entrance to the upper air-closed chamber is obtained through an opening in the top, and when the workmen are all in, the opening is sealed up and the clamps over the opening to the lower chamber are removed, and the bed of the river is reached by means of a ladder. Before the workman goes on board, however, all the water will be removed from all the chambers by air pressure, which will vary from 2½ lbs. to 15 lbs. per square inch according to the depth to be reached. On reaching the river bed, clamps are removed from the elevator shaft and the workmen begin excavating, and shovel the dirt into a bucket in the elevator. When the bucket is full the elevator shaft is closed tight, a signal is given, and the shaft is opened at the top, the bucket is hauled up and its contents emptied on to the dump. It is then lowered into the shaft, which is again hermetically closed at the top, a signal is given and the fastenings below are removed, so that the whole process can commence again. C. C. Bennett, of F. C. Innes Co.'y, Ltd., Vancouver, B. C., is the agent of the invention for Canada.



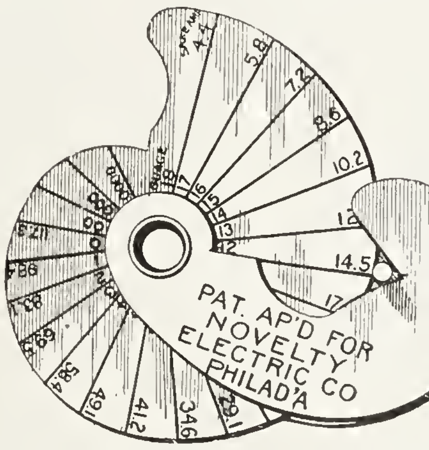
THE CAISSON ELEVATOR IN OPERATION, SHOWING MEN AT WORK IN BED OF RIVER.

REFRIGERATING MACHINES.

A correspondent of Fairplay, London, writes: As a result of the recent extensive additions J. & E. Hall, Limited, have made to their works at Dartford, Kent, which, by the way, is the third time this has been necessary during the past few years, I hear that they have been turning out refrigerator machines on their patent carbonic anhydride system for the last four months at the rate of fifteen per month, that is to say, a total of sixty machines in four months. This is a result that they may well be proud of, as many of the machines were of large size, such as those for Houlder Bros. & Co.'s two latest ships, which have a capacity for over 2,000 and 3,000 tons weight of meat respectively; also those for the White Star Line for their S.S. Nomadic and Tauric for the carriage of chilled beef; machines for the United Steamship Company of Copenhagen for the carriage of about 900 tons of butter and bacon in each ship; and for Thos. Wilson, Sons & Co., in the same trade. The British Admiralty have had several more machines from Messrs. Hall, and the new Japanese battle ships have been fitted by them. For the carriage of fruit and preserving provisions, etc., Messrs. Hall have executed further orders for the Union Steamship Company and Donald Currie & Co. Other machines have been supplied to the Oriental Steamship Company of Japan, the Nippon Yusen Kaisha, Baron Rothschild's new twin-screw yacht, the Atmah, the Russian Volunteer Fleet, and many other vessels. They still have in hand orders for no less than 75 machines, either fitting or to be fitted on board ship, besides a large number of machines for land purposes, which comprise almost every trade for which refrigeration is required. It is interesting to note that J. and E. Hall have fitted and have on order for the largest steamship companies no less than nine installations each for two of those companies, also orders from seven other companies that run into from four to six installations apiece, and orders for ten, seventeen, eighteen, twenty-three, twenty-eight and thirty installations respectively, for other companies. A description of some of these machines will appear in another issue of The Canadian Engineer. The London office of the company is at 23 St. Swithin's Lane.

HOW TO USE THE ELECTRIC WIRE GAUGE.

Place the wire in the V-shaped opening between the movable arm and the edge of the gauge. Move the arm around until the wire is tightly bound against the edge. On the front of the gauge the figures above the short, square shoulder, near the centre, show the American (B. & S.) gauge of the wire. The figures on the outer edge of the gauge on small line, show the amperes the wire will safely carry before heating to 30 degrees above the temperature of surrounding air. On the back of gauge the ohms resistance is given of a foot of copper wire, of any size, as shown by the gauge. To find the resistance of a foot of iron wire, multiply the resistance of a foot of copper wire by seven (7). To find the resistance of a foot of German silver wire, multiply the resistance of a foot of copper wire by thirteen (13). To find the number of lamps a wire will carry: Bear in mind that a 50-volt lamp takes 1 ampere, a 75-volt lamp ¾ of an ampere, and a 110-volt lamp ½ an ampere of current. From the gauge, get the size of wire and its safe carrying capacity in amperes. The wire will carry as many lamps as the current of one lamp of a given voltage is contained in the ampere capacity of wire, as shown by gauge. Example.—The safe ampere capacity of No. 12 copper wire B. & S. Gauge is 14½ amperes, and one 110-volt lamp requires ½ ampere of current; therefore, $\frac{14\frac{1}{2}}{\frac{1}{2}} = 29$, the number of lamps a No. 12 B. & S. gauge, copper wire, will carry. To find the size of wire required to carry a given number of lamps, at a given distance, at a given loss.—Taking the formula as stamped on arm gauge: Let V represent the volts loss, C represent the total amperes and D represent the distance in feet (both ways). Example.—Desiring the size of a feeder-wire that will carry 20 amperes at a loss of 10 volts, 400 feet (800 feet both ways). V = loss in volts, which, in this case, is 10; C = total amperes, which, in this case, is 20; D = total distance in feet, both ways, which, in this case, is 800. Therefore, $\frac{10}{20 \times 800} = \frac{10}{16{,}000}$ = .000625, the resistance of one foot of copper wire. Having this result, place the square shoulder of the gauge-arm on line with the nearest resistance to said result that is found on the gauge, and the square shoulder on the reverse side will indicate the B. & S. copper wire gauge desired; in this sample case, it will be found to be No. 8 wire. For sale by Aikenhead Hardware Co., 6 Adelaide street East, Toronto.



James Stewart & Co. are at work on the foundations of the new bridge to be constructed across the Niagara River at Lewiston.

The St. John, N. B., Globe says: The building of the Cushing Sulphite Pulp Company's mill is now an assured thing, for one English paper maker has taken three-quarters of the stock and more than one-half the remainder has already been subscribed by local capitalists.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during July and the seven months ending July, 1897, 1898 :—

	Month of July.		Seven months ending July.	
	1897.	1898.	1897.	1898.
Hardware and cutlery	£5,825	£2,372	£37,755	£14,290
Pig iron	942	928	3,807	7,105
Bar, etc.	786	502	5,799	7,239
Railroad	17,368	8,190	37,654	23,007
Hoops, sheets, etc.	8,313	7,843	31,003	24,466
Galvanized sheets	6,083	8,294	25,458	32,461
Tin plates.....................	5 989	12,123	94 942	85,598
Cast, wrought, etc., iron	1,943	2,295	19,277	18,637
Old (for re-manufacture)	1,080	499	2,577	3,574
Steel	6,099	5,040	29,537	32,897
Lead	3,699	4,170	10,959	16,460
Tin, unwrought	345	1,638	10,179	12,423
Alkali.........................	2,289	3,587	17,649	24,597
Cement......................	1,934	2,270	8,489	12,222

THE USE OF IMPROVED METERS IN ELECTRIC LIGHTING.

It has been found by experience, it is stated, that a central lighting station can supply 30 per cent. more customers on the meter than on the flat rate. This 30 per cent. really represents wastefulness, which is inherent in the nature of the average customer, and the flat rate. The investment in meters, and their proper care, makes the plant equivalent to one 30 per cent. larger. A central station which is in the electric lighting business for the profits on its investment can easily realize the great advantage in the use of meters. That many small villages and cities make but a small profit, or the income only sufficient to pay actual running expenses, is not surprising, in view of the waste and extravagance of the flat rate. These same stations may, by proper and economical use of meters, be made profitable. It is not necessary to point out the evils of the flat rate; but it is self-evident that many customers never take the trouble to turn out all or part of their lamps, and in places where the plant gives all-night service the lamps are left burning all night. A fallacy in flat rates is the basing of charges on 50-watt lamps. A 50-watt 16-c.p. lamp is somewhat of a rarity in the market, 60 watt being about an average, and many lamps are used taking more even—70 or 80-watts. In most small stations the voltage is kept above what the lamps were made for; even in the case of a 50-watt lamp the consumption will be higher. It has been found that most small stations, if they use 50 volts, keep the voltage at 55 or 60. These wastes are impossible to avoid in the flat rate. A meter measures the actual consumption of current. The central station gets paid for actual service given the customer, and it behooves the consumer to use his lights in the best and most economical way.

New Scheefer watt-meter for alternating current has been devised to correct various faults which were in the Scheefer meter, which has given such good results, states the Packard Electric Company in a recent circular. As will be noticed, the meter is round and has a rubber band placed around the circumference, over which is placed the other case. This rubber band should always be used, as it makes the meter perfectly dust and bug proof. It has been found that meters with cases of ordinary fitting are hampered with dust and dirt; and with such cases it is impossible to keep meters correct, necessitating frequent overhauling and cleaning. The Packard Company's new meter, if the case is properly put on with the rubber band, is perfectly air tight, and gives an assurance of its permanency. The binding posts will be seen to be insulated in a thorough manner, ordinary holes not being depended upon. The holes in the binding part are closed on end and insulated by hard rubber, making it impossible that anything can get through the post; and also making it unnecessary to tape or plug any holes. The moving parts are extremely light—at the same time not too delicate. The iron circuit in the magnetic system is practically a closed one, preventing stray lines of force from acting on other parts of the meter, and is therefore unaffected by outside influences. This closed circuit gives the maximum effect with the minimum energy possible in construction, the shunt winding taking about 1-3 to 1-2-watt on 15,000 alternations, and not exceeding ½ to ¾-watt on 7,200 alternations. This meter is also said to be correct on inductive loads, and therefore can be used on fan motors or induction motors, arc lamps, etc.

Industrial Notes.

Joseph Carrington is building a large addition to his tannery at Kingston, Ont.

Mayor Roy, of Levis, is negotiating with Montreal capitalists for funds for an aqueduct for that town.

Dr. Bryce of the Ontario Board of Health has reported that additional sewers are needed at Kincardine, Ont.

The Ontario Silver Co., Humberstone, Ont., has installed a second gas engine recently; the new one being 40 h.p. capacity.

H. Mooers & Co., of Kingston Ont., are about to build a new flour mill, which will be run in connection with their elevator.

Lancaster, Ont., village corporation is looking for some industry or industries to locate in the town. Good inducements are offered.

It is said that a shoe factory is soon to be established at Fredericton, N. B.; $20,000 of the required capital has already been subscribed.

McDonald & Allen, manufacturers of door knobs, Kingston, Ont., have closed out. The plant has been bought up by Mr. Spencer, who will reorganize the business.

M. Fauteux has the contract of building the new hospital at Sault Ste. Marie. The work is estimated to cost $20,000, and is to be completed by the 10th of January, 1899.

Engineer C. H. Mitchell, Niagara Falls, Ont., writes that the town is about to construct 8,700 lineal feet of 6, 8 and 10 foot concrete and brick walks, together with stone curbing and crossings.

The Peterboro, Ont., Light & Power Co., is about to commence the erection of a large water power station. The new station will cost between $30,000 and $40,000, and the company expects to develop about 2,000 h. p.

The contracts for the new iron bridge over the River Raisin at Lancaster were let, and Williams & Fallon, of Cornwall, Ont., have commenced work on the abutments. The Dominion Bridge Co. will supply the structural work.

The Ontario Board of Health has given Fort William, Ont., permission to take the supply of water from the Kaministiquia River three miles above the town, provided that the sewer outfall should be a quarter of a mile from the mouth of the river, emptying into the bay.

It has come to our knowledge that certain bogus or fraudulent firms in Holland are entrapping Canadian manufacturers in the iron trades, and we would sound a note of warning that no goods be shipped without security in some form. Could not our boards of trade look into the matter ?

The demand for Clappison's magnesia sectional covering has been so great that it has become necessary to greatly enlarge the factory at Hamilton, Ont. Another story and a new engine room—an entirely new front—new machinery, etc., having been added. This goes to prove that a really good article, once used, is sure to be appreciated.

The hydraulic jacks recently shipped to the Intercolonial Railway Co. by the Lancaster Machine Works, are reported to be first-class articles giving great satisfaction. These jacks, although retaining the main original features of the Tangy jacks, have several improvements that place them ahead of all other makes. They are made in all sizes by the Lancaster Machine Works, Lancaster, Ont.

In the paragraph last month referring to the transfer of certain oil properties to the Bushnell Co., Ltd., of Sarnia, omission was made of the transfer of the National Oil Co., of Petrolia (owned by John Macdonald), at $65,000. The price at which the Empire Oil Co., of London (owned by J. R. Minhinnick), was transferred was stated to be $4,000 instead of $28,000.

The Athens, Ont., Methodist congregation will build a new $10,000 church.

Newmarket, Ont., has carried a by-law to give $5,000 to the Office Specialty Manufacturing Co. to extend its buildings.

The contract for the Ashburnham waterworks system has been awarded to McQuillan & Co., of Toronto, at $6,295.

The new ranges of the Dominion Rifle association at Rockcliffe, Ottawa, are provided with acetylene gas lights instead of electric lights.

J. E. Webb, who was contractor for the masonry on the Union station, Toronto, is building a large generator house for the Consumers' Gas Co., Toronto.

Jno. Galt, C. E., Toronto, has made preliminary surveys and examinations at Stayner and Bolton, Ont., for the proposed installation of waterworks in those towns.

The matter of the contemplated bonus to the proposed rolling mills in Belleville, Ont., will not come before the ratepayers for some time, as a great deal of opposition has recently developed itself locally.

Dr. P. H. Bryce, secretary of the Ontario Board of Health, reports that the residents of Niagara-on-the-Lake are taking the sewerage question into serious consideration, and hope in a short time to have a modern system in operation.

Alex. P. McKee, proprietor of a glass factory in Anderson, Ind., was recently in Hamilton, Ont., with a view to establishing a factory there. The report that the Diamond Glass Company proposed to move to Toronto was the cause.

In St. John, N. B., the city engineer is carrying on the annual clearing of the city water mains. In the leading Ontario cities when the water mains become choked up with sediment they lay new and larger ones.

The waterworks just completed in Mount Forest, Ont., were tested August 30th, and found entirely satisfactory. The work was carried out at a cost of about $30,000 by Clark & Connelly, contractors, Toronto, upon plans prepared by Jno. Galt, C. E., Toronto.

D. S. Collins, manager of the Fossil Flour Company's mills at Bass River Lake, Castlereagh, Londonderry, N. S., is pushing the works, and the product that is now coming from the mill is said to be most satisfactory. The mill is turning out from 10 to 13 tons of refined silica every day. It is brought over the Pole Railway to the wharf at Bass River for shipment.

The Brockville Pork Packing Company has been organized with W. H. Comstock as president; Mr. Packingham, treasurer; Mr. McLennan, secretary, and E. C. Manning, formerly of Dublin, Ireland, as manager. The buildings for the new company are being got into shape, and the factory will soon be running.

Last month an article appeared in the columns of The Canadian Engineer describing the Sterling Hack Saws, which are a great labor-saving device; the makers' name and that of the parties selling same in Toronto were omitted. The Diamond Saw & Stamping Co., of Buffalo, manufacture these goods, and samples will be sent free and prices quoted on same by Aikenhead Hardware Co., 6 Adelaide street east, Toronto.

The Britannia Co., of Colchester, Eng., have sent us a neat souvenir in the form of a nine inch rule with one edge beveled to form a letter opener. This company manufactures various specialties in tools, and has just issued leaflets descriptive of their lathes with turret rests and capstan rests, for milling machines, and headstocks for the same, dividing appliances, engineers' vices, turret screw cutting lathes, boring machines, shapers, etc.

The General Engineering Co., of Toronto, Ltd., are prosecuting an action, taken out last July, against the Dominion Cotton Mills Co., of Montreal, and the American Stoker Co., for infringement of patents. The statement of claim sets forth that the plaintiffs are owners of patents granted in 1892 and subsequent years for improvements in boilers and furnaces and for mechanical stokers, known as the Jones Underfeed Mechanical Stoker, which patents the defendants have infringed. Damages are sought for these infringements, and an injunction is asked for restraining the defendants from using such mechanical stokers, etc. The action is taken in the Exchequer Court.

A bonus of $2,500 is offered for the erection of a 50-barrel flour mill at Carnduff, Assa.

D. W. Karn & Co., Woodstock, are erecting a $3,000 addition to their organ factory.

Charters Smith, Durham, Ont., has his foundry, which was burned down some time ago, in operation again.

Geo. H. Hees & Co., Toronto, window shade manufacturers, have taken out a building permit for a three-story brick factory to cost $9,000, and a three-story brick warehouse, beside the factory, to cost $7,000.

Oshawa, Ont., has instructed Jno. Galt, C. E., to make preliminary surveys and estimates for a system of water supply and sewage disposal for the town, to cost about $100,000. The water supply is to be by gravity from springs in the Oak Ridges.

The difficult work of taking down the old Victoria bridge, Montreal, is being made somewhat easier by the use of pneumatic machines to cut the old rivets. The Ontario Rolling Mills Co., Hamilton, Ont., has bought the material of the former structure.

A great many elevators are being bult in the Northwest this season. The Northern Elevator Co. has ten elevators under construction at the following points: Oak River, Vareoe, Pettypiece, Cypress River, La Salle, Starbuck, Elm Creek, Somerset, Swan Lake and Union Point, Man. Each of these will have a capacity of 30,000 bushels, and a few others will be erected later on in the season. When those mentioned are completed the Northern Elevator Co. will have 102 elevators in the province and Territories. Besides the five to be built for the Lake of the Woods Co., E. J. O'Reilly has about completed an elevator for the Richardson Grain Co., of Kingston, at Sydney, to replace the one destroyed last winter. The Manitoba Grain Co. will also erect a number, and it is understood the Dominion Elevator Co. will add to their storage capacity. Bready, Love & Tyron will spend about $50,000 in erecting elevators at thirteen or fourteen provincial and Territorial points.

The Dodge Manufacturing Co., Toronto, Ltd., has been incorporated and will carry on the business hitherto conducted by the Dodge Wood Split Pulley Co., with works at Toronto Junction, and warerooms and city offices at 74 York street. The Dodge Manufacturing Co. will continue to manufacture the Dodge Wood Split Pulley. It will also do a general foundry, engineering and machine shop business, making a specialty of power transmission machinery, such as shafting and pulley equipment, jack shafts, floor stands and friction clutch pulleys. The firm will also make a specialty of grain elevator machinery and rope driving. The Dodge Co. has every facility for turning out high class work quickly, and are prepared to make plans and submit estimates and give information on all kinds of special machinery. The company issues a 270 page catalogue which will be mailed free on application.

Freeman C. Coffin, engineer to the city council of Carlottetown, P. E. I., prepared the plans adopted by the Sewer and Water Commissioners for a complete sewage system for the city. The system decided upon is the common separate water carriage system with intermittent discharge into the sea by means of a reservoir, cast iron pipe and the channel of the Hillsborough. There will be a pumping station at a low point both on the east and west sides of the central high gravity area, which location of pumps will altogether obviate the use of siphons and at the same time carry away the sewerage from the lowest levels to the eastern and western portions of the city. From each of the pumping stations already mentioned, and the tank connected therewith, the sewerage will be pumped through a cast iron pipe to an elevation of about 20 feet on the high gravity area, where it will enter an earthenware pipe of a large size to enable it to flow freely with the other sewerage passing at the same level into the outlet reservoir. It is proposed to erect an outlet reservoir at or near the head of Pownal wharf, 40 feet by 90 feet inside measurement. This reservoir will be covered with an arch roof of concrete, to effectually guard against the escape of any foul odors. From this reservoir, running between Pownal and Connolly's wharves, there will be a 20 inch cast iron outlet pipe of the approximate length of 700 feet, or until it reaches well out into the channel of the Hillsborough.

Parry Sound, Ont., has ordered a rock crusher.

The village of Gatineau Point, Que., has voted to establish water-works.

The contract for the new breakwater to be constructed at Goderich, Ont., has been awarded to Sneeth & McGillicuddy.

J. A. Savoie, box manufacturer, Brompton, Que., will move his factory to Sherbrooke, where he will employ about fifty men.

J. E. Wilson, St. John, N.B., has received from the C.P.R. the contract to furnish 3,000 steel buckets for the new elevator conveyors.

Mayor Andrews, of Winnipeg, has gone to England to float a bond issue to provide for the construction of a city water-works system.

It is proposed to erect the new dynamite works of the Ottawa Dynamite Company on a site between the Ottawa river and the Richmond road.

The Waterloo township, Waterloo County, Ont., by-law to raise $9,000 for the purpose of replacing the bridges swept away, was carried last month.

A by-law to provide $40,000 for waterworks purposes, repealing the by-law for $35,000 already voted, was defeated in Fort William last month.

Voting on a by-law for the establishment of a waterworks system, took place at Prescott, Ont., Aug. 18th, and it was carried by a majority of 124.

Berlin, Ont., has an old hand fire engine that has a history. It was purchased on December 19th, 1857, from George Penny, of Montreal, for £219 9s. 11d.

The contract for the building to be erected on the site of the old City Hall, Quebec, has been awarded to Joseph Gosselin, of St. Joseph de Levis, at $75,000.

A bylaw to raise the sum of $30,000 for the purpose of erecting new municipal buildings, in place of those burned last November, was carried at Stratford recently.

Wm. Thompson, expert of the Caledonia Iron Works, reports that he is making rapid progress with the installation of the waterworks plant at Rat Portage, Ont.

A Dominion charter is asked for a company to build a general traffic bridge over the Ottawa from a point in Ottawa city, between Bank and Kent streets, to the city of Hull, Que.

Recent fires in Montreal have caused an agitation for fire tugs, which are necessary to the protection of a harbor, and are in use in all the chief harbors of the United States.

An elevator is being erected at the linseed oil works, Winnipeg, and considerable new machinery has been installed in the works, increasing the capacity and efficiency of the industry.

The acetylene gas plant installed this summer in the Algonquin hotel, Stanley Island, Ont., by the Hamilton Acetylene Gas Machine Co., is giving complete satisfaction. There are 150 lights.

Dickson Bros., iron founders and machinists, Campbellford, Ont., have been awarded the contract for the steel bridge across Crow River, eight miles north of Campbellford, for $1,900.

The People's Light & Power Co., Halifax, N. S., has added to its plant by purchasing through the Halifax office of the James Cooper Mfg. Co., another 50-h. p. Lidgerwood hoisting engine.

The contract for the re-building of the portion of St. Bernard's Convent, Antigonish, N.S., destroyed by the recent fire, has been awarded to Angus McDonald & Son, Truro, N. S. Their tender was $11,342.

The W. C. Edwards Co., Ottawa, is erecting a retort for the manufacture of calcium carbide gas from sawdust and limestone. A description of the process will appear in an early number of the CANADIAN ENGINEER.

The Reids of Montreal have laid before the Newfoundland Government their plans for the erection of a pulp mill at Grand Lake. It is to be a company with a capital of $2,000,000, which has already been subscribed. The mill is to have the capacity of 162 tons of dry pulp per day, and for this purpose will use 450 cords of spruce daily.

The assets of the Cascapedia Pulp & Lumber Co. were sold at auction recently. R. H. McLelland, of St. John, N.B., bought the saw mills and machinery for $15,000, and the Salmon River timber limits for $2,900.

An order has been placed with the James Cooper Mfg. Co., Ltd., Montreal, by the Canadian Construction Co., Farrans Point, Ont., for two of the Lidgerwood type double cylinder double drum hoisting engines, complete with boilers.

Architects are asked to compete for plans for a Presbyterian church, Windsor, N. S., seating capacity 500 or thereabouts, and of schoolroom 250, of wood, to cost not more than $12,000 fully finished, including lighting and heating; if of stone, to cost not more than $16,000, finished, lighted and heated.

The Nova Scotia Glass Co., South Trenton, N. S., has sold its works and plant to the Diamond Glass Co. The works have been closed since 1892.

Later reports show that the damage to the works of the Jenckes Machine Co., at Sherbrooke, Que., by fire on the night of the 13th of August, was very much exaggerated. The fire was confined to the machine shop building, and the other departments, foundry, boiler shops, etc., were in operation as usual on the following Monday. A few days later a portion of the machine shop was started up, and the whole was in running order in a very short time. The patterns, drawings and office records were preserved practically intact, and all orders for work are being accepted as usual. The principal item requiring replacement is the roof of the machine shop; this, however, is well under way. The whole of the work is being pushed with much energy, and the numerous orders in hand will suffer comparatively slight delay.

The International Correspondence Schools, of Scranton, Pa., have decided to place representatives in the Canadian field, and will in a short time open an office in Toronto for the extension of their business. This is an institution that wants the consideration of all steam engineers, as they aim to give a technical education in engineering to all who will study. For starting as they do at arithmetic, they are prepared to teach anyone who can read and write. No previous knowledge of the subject is required, and anyone who will study can learn. Two of their representatives, Geo. Carruthers and J. E. Taylor, have been in Toronto for some time, and are very much encouraged by the interest shown in the schools. Their address at present is 226 Jarvis street, and they will be pleased to answer any enquiries, personally or by mail, regarding the various courses taught. They have some 1,400 students in Canada, and will be glad to give the names and addresses of any of these for reference.

Marine News.

A. Nichols, of Carleton Place, has bought a steam yacht.

The Chateauguay and Beauharnois Navigation Company, Ltd., capital $9,100, has received a Quebec charter.

Wm. Thomson & Co. are negotiating for the purchase of a steamship of 5,800 tons dead weight to be ready for delivery in November, to replace the Arbela.

The steamer "S. L. Tilley" has come out of the Kingston dry dock, where she has been undergoing extensive repairs. She has started for the upper lakes.

M. J. Hogan, of Section 12, Soulanges Canal, has placed an order with the James Cooper Mfg. Co., Ltd., of Montreal, for three of the latest type Sergeant drills.

M. A. Cleveland, contractor, of North Channel, found that he has considerably more work than anticipated, and has put in three more Ingersoll-Sergeant drills.

The steamship Leuctra Company has applied for a New Brunswick charter to own and sail the steamer Leuctra; chief place of business, Rothesay, N. B.; capital, $160,000.

The engines have been placed in the new C. P. R. steamer Queen City, and carpenters are busy finishing her deck house and fittings. She will be ready for service in about a week.

The machinery has been taken out of the steamer Carleton at Carleton Place, Ont., and the hull is to be fitted up as a barge for carrying passengers in tow of the Commodore.

The steamer Macassa was run into recently by the Ella Merton, owned by Elias Rogers & Co. The Macassa had the front part of the upper deck and the wheel house demolished. The schooner suffered the loss of her sails and jib-boom.

The Harbor Commissioners of Montreal invite offers furnishing them with land suitable for the site of a dry dock. The land must be on the north bank of the River St. Lawrence, between the Sugar Refinery and the Longue Pointe church. Lots offered must have a depth of not less than 600 feet from the boundary of the harbor lands to the Quebec Turnpike road, the breadth required being about 600 feet.

C. Giguire, under contract with the corporation of Quebec, has just built a large pontoon for the Champlain market wharf, for $9,186. This pontoon, the third of the series of new ones for the market and ferry boats, plying to the city wharf, is like the other two which were built in 1896 and 1897, 120 feet in length, 40 feet broad and 8 feet high or deep, conformably to plans and specifications prepared by C. Baillairge, city engineer, and under his superintendence and that of Foreman Verrault.

The K. M. T. & T. Co. and the Lake Bennet & Klondyke Navigation Co., have amalgamated, at least so far as their transportation business is concerned. Hereafter the latter company will have charge of all transportation matters, the steamer Amur, owned by the K.M.T. & T. C., being run by them in connection with their river steamers Oro, Nora and Flora, plying between Dawson and Bennett. The K. M. T. & T. Co. taking the offices in the Five Sisters Block and the Bennett Lake & Klondyke Company removing to the Government street offices.

The Esquimalt Marine Railway, Ltd., has sold out the plant and ship building business to a company which has been formed under the name of the British Columbia Marine Railway Co., Ltd. The new company, which has been incorporated with a capital of $200,000, has taken over the business as a going concern, the sale dating from July 27th. In addition to the large plant at Esquimalt which is capable of handling ships up to 2,500 tons, the new company intends to put up a smaller plant in the inner harbor for handling smaller vessels and will extend its business too to Vancouver, where it has already secured a site.

The new slip docks at Port Stanley, Ont., the contracts for which were awarded by the Lake Erie & Detroit River Railway Company late in May, will be completed and ready for use in a few days. The contracts called for their completion on Aug. 1, but unavoidable delays prevented their being finished in that time. The docks are being constructed immediately to the west of the light-house piers, and with the tracks and grading of the approaches, they will cost in the neighborhood of $55,000, the estimated cost of the docks alone being $45,000 and of the approaches $10,000. The contractors are the Hamilton Bridge Company for the iron work, and Babcock & Flook, Windsor, Ont., for the woodwork.

Railway Matters.

The new I. C. R. station at Moncton, N. B., was opened to the public, August 1st.

Trains are now running on the New York and Ottawa Railway between Ottawa and Cornwall, Ont.

Track laying on the Swan River extension of the Dauphin railroad is now going on, about 35 miles of grade being ready.

The new Grand Trunk offices in Montreal are to be a magnificent structure, the largest railway offices in the world. R. A. Waite, Buffalo, is the architect.

Mackenzie & Mann let to E. F. Farquhar, Toronto, the first 25 miles of work on the Ontario & Rainy River Railway. Locating parties are already in the field. Thomas White is chief engineer.

At a recent meeting of the Board of Directors of the Canadian Pacific Railway Company, dividends of 2 per cent. on the preference stock and 2 per cent. on the common stock for the half year ended 30th June last were declared, payable 1st October.

It is stated that the proposed railway from Brandon to Deloraine will be built this year, with a spur to the coal district south of Deloraine, where it is said a plant for mining coal will be put in.

Casper Braun, contractor, Berlin, who erected the G. T. R. depot in that town, has been asked by the Grand Trunk authorities to tender for the erection of a large round-house at Sarnia, to house 30 engines in.

The Brandon Southwestern Railway survey party has been gradually working its way north to Brandon, and has now reached that town. It is expected that the road will connect with the Great Northern at Bottineau, U. S.

With a view to completing the double track on the Montreal and Brockville section the Grand Trunk Railway authorities are at present engaged in widening the bridges at St. Annes and Vaudreuil, in order to place an additional track on each.

Work is progressing satisfactorily on the Restigouche & Western. A large force of men is employed under C. L. B. Miles, engineer in charge. It is expected that ten miles of rails will be laid early in October, and a second ten miles graded. The first sod was turned August 12th.

The Brotherhood of Locomotive Firemen will, this month, celebrate in Toronto its twenty-fifth anniversary, and the sixth bi-ennial convention, beginning on the 12th. The Locomotive Firemen's Magazine has issued a handsome illustrated supplement showing a number of views of Toronto and portraits of the officers.

Application will be made at the next session of the Ontario Legislature for an Act to incorporate the Haliburton, Whitney & Mattawa Railway, to construct a railway from a point at or near the present terminus of the Grand Trunk Railway at Haliburton, to a point on the Ottawa, Arnprior & Parry Sound Railway, at Whitney, Ont., and in a northerly direction to Mattawa on the Ottawa River, with power to equip and operate it by steam or electricity.

The Grand Trunk Railway is making considerable additions to its rolling stock at the present time. It has just received from the Pullman Company twenty passenger coaches,, which will be used on the western division of the road. Mammoth engines are being specially purchased to haul these new coaches. The company is now busy building 500 box cars in its shops at Detroit, and also 250 new stock cars.

E. C. Walker has been elected president and managing director of the Erie & Huron Railway. S. A. King vice-president, and J. H. Walker treasurer. John Forman remains secretary The following appointments have been made in the office at Walkerville: William Woollyatt, general superintendent and traffic manager; A. Leslie, accountant and auditor; J. H. Coburn, solicitor; Owen MacKay, engineer; S. Austin, mechanical superintendent; H. Morris, road master.

The Sooysmith Co. finished pier No. 8, the last of their work in connection with the Cornwall bridges of the O. & N. Y. Railway, last month. In less than seven months' work time ten piers, averaging about 1,000 yards of masonry in each, and four concrete abutments have been built, and with the single exception of the killing of Johnston by the falling of a tower, not the slightest casualty has occurred, nor a man been sent to the hospital.

W. T. Jennings, C. E., engineer of the James Bay Railway Commission, has returned to Toronto after making a preliminary survey of the Temegami & Wahnapitae districts to the Height of Land, having made a canoe journey of 700 miles. Mr. Jennings sent Mr. Sankey on to James' Bay to examine the bar at the mouth of the Moose River, and to report on the possibilities of constructing harbors on the south shore of James' Bay. Mr. Sankey is expected back as we go to press, and Mr. Jennings' report will be awaited with interest.

An important railway deal was closed Aug. 20th, when the Toronto General Trusts Company, representing the estate of the late John Leys and other trust interests in their keeping, negotiated the sale of the Port Arthur, Duluth & Western Railway to Mackenzie, Mann & Co., for a price said to be in the neighborhood of a quarter of a million. It is understood that it is the intention of Mackenzie & Mann to extend the road forty or fifty miles into Minnesota to connect with the railway systems of the Northwestern States. It is also intended to connect it with the Rainy River Railway, a charter for which Mackenzie & Mann have secured and on the construction of which they are now working.

Mining Matters.

A 30-barrel oil well has been struck on the farm of F. W. Smith, Dunwich, Ont.

It is said that a valuable deposit of copper has been discovered at Wickham, Que.

A placer strike has been made on Rover creek, near Nelson, B. C., and many claims are being staked out.

The Libbey mine, Brookfield, N. S., cleaned up in July over 350 ounces of gold aside from the concentrates.

There is a report that gold in paying quantities has been found near Pinmaukin, on the head waters of the Rivers Shipshaw and Bersiamites, Labrador.

A natural gas well has been struck on the farm of Jacob Smith, near Ryckman's Corners, Ont. James Marshall, Barton, Ont., is the owner of the well.

The Nova Scotia Steel Co. has an order for 70,000 tons of iron ore from a German smelting company. The ore will be shipped from the Belle Isle mine.

Very rich mica has been discovered in the neighborhood of Kazabazua, Ottawa county, Que. The mine is turning out mica large enough, it is said, to cut 14x22 inches.

It is reported that a seam of anthracite coal has been located at Macadam's Lake, about 15 miles from Sydney, C. B. Dr. Gilpin gives an opinion that is favorable to the find.

The Trail Smelter, Trail, B. C., is increasing its boiler plant and has placed an order with James D. Sword, representing the James Cooper Mfg. Co., Ltd., Montreal, for another 80-h.p. boiler, to be added to the present battery.

The Hall mines, Ltd., Nelson, B. C., is re-equipping its tramway line with a complete new set of buckets, and has placed the order with James D. Sword, of the James Cooper Mfg. Co., Ltd., for 810 buckets. Delivery is to be made within eight weeks.

The James Cooper Mfg. Co., Ltd., is now erecting for the Whitewater Deeps Mining Co., Whitewater, B. C., complete 10-drill Ingersoll-Sergeant air compressor plant of the belt driven type, and installing Pelton water wheels with half a mile of converse lock-joint pipe and a mile of air line pipe.

It is said that the United States prospectors who are boring for oil at Lake Ainslie, C. B., have reached a depth of 1,600 feet, and were compelled to desist for want of further appliances to work at that depth. It is reported that the indications continue to be favorable and numerous as to the presence of petroleum in this neighborhood.

The Council of the Canadian Mining Institute has decided to hold the next meeting of the members at Nelson, B.C., early in October. Although it is yet too early to indicate a programme, we understand that already a number of papers have been promised, among the writers being: W. Blakemore, Crow's Nest Coal Co., Coal Creek; Wm. Braden, M.E., Pilot Bay; J. G. Gwillim, M. E., Slocan City; H. Perry Leake, M.E., Revelstoke; J. L. Parker, Rossland; O. E. S. Whiteside, M.E., Anthracite; H. A. Guess, Keewatin, Ont.

The Bannockburn, Hastings County, Ont., mine has just placed an order with the James Cooper Mfg. Co., Ltd., for a 30-horse power Lidgerwood hoisting engine with necessary boiler, pump, etc. This firm's erecting engineer has just returned to Montreal after completing the installation of a plant for the Regina Canada Gold mines, Ltd., Rat Portage, Ont. This consists of a 15-drill cross compound condensing Ingersoll-Sergeant air compressor, battery of boilers, ten drills, etc. Secretan & O'Boyle, Rat Portage, Ont., have increased their plant by ordering through the James Cooper Mfg. Co.'s Ltd., agent at that point, Ingersoll-Sergeant drills.

The Chatham Oil Company are boring three new wells at Thamesville, Ont. The large well struck by this company some time ago is still pumping fifty barrels per day.

The Noble Five Mining Co., Sandon, B. C., has just installed a new 7-drill compressor plant supplied by the James Cooper Mfg. Co., Ltd., Montreal, together with 1½ miles of pipe line and necessary accessories for the plant.

The Dufferin mine, Salmon River, N. S., plant is now running at its full capacity. It consists of an Ingersoll-Sergeant 15-drill cross compound condensing compressor, one 40-horse power and one 50-horse power Lidgerwood double drum double cylinder hoisting engine, battery of boilers, complete complement of drills, mountings, etc., all supplied by the James Cooper Manufacturing Co., Ltd., Montreal. This enterprising firm has received an order from the North Brookfield, N. S. Mining Co., for two more hoisting engines, one to increase the present plant, and one for new property that is being opened up. The Broad Cove Coal Co., of Broad Cove, C. B., has just installed an Ingersoll-Sergeant piston inlet air compressor, and complete coal cutting plant purchased through the Halifax office of the James Cooper Mfg. Co., Ltd.

The Rossland, B. C. branch office of the James Cooper Mfg. Co., Ltd., reports that its erecting engineer has returned from Anaconda, B. C., where he has been erecting a 12-drill compressor plant for the British Columbia Copper Co. The Athelstan Gold Mining Co., Rossland, B. C., has placed an order with J. D. Sword, representing the James Cooper Mfg. Co., Ltd., for preliminary plant, consisting of hoisting engine, boiler, pump, etc. The Liberty Mining Co., with headquarters at Rossland, B. C., has installed an Ingersoll-Sergeant piston inlet compressor with full complement of drills, etc., having purchased this through the Rossland branch of the James Cooper Mfg. Co., Ltd. The B. A. Corporation, Rossland, B. C., reports that it has both compressors that were installed by the James Cooper Mfg. Co., Ltd., of 12-drill and 5-drill capacity respectively, now running, and development work will be proceeded with with great vigor. This company in the Great Western Nickel Plate, West Le Roi and Josie is operating 19 Ingersoll-Sergeant drills.

The Messrs. McGregor's attempt to work their property at Fifteen Mile Stream, N. S., open cast or quarry fashion, has had to be abandoned. The quartz which it was expected to strike was not met with, and that crushed bore so little gold that it would be a loss to work. This is a disappointment after the very heavy outlay of late. So complete are the arrangements at this mine, and so excellent the machinery, that quartz in larger leads yielding a dollar's worth of gold to the ton can be worked to advantage. But we are glad to learn that the disappointment of the owners soon gave place to satisfaction. A shaft was planned to be sunk a depth of a hundred and fifty feet, at a distance of fifty feet or so from the open cast. At that depth paying quartz was expected to be met with. The shaft, however, had not gone twenty feet when it was found the large lead showed gold all round. Besides the quartz from this shaft other quartz will be mined from what is known as the 'Orient' mine, which after being idle for a long time has been pumped out. From these two shafts it is expected sufficient material will be obtained to keep the fifty stamps fully employed. The cable road built for the open cast can be utilized in taking one from the new shaft.

Electric Flashes.

A company of American capitalists talk of utilizing the water power of the Jacques Cartier river for electrical purposes.

The promoters state that the necessary capital has all been subscribed for the power development at Fenelon Falls, Ont.

The Electric Co. of Windsor, N.S., has ordered a 100 horse power, Robb-Armstrong engine from the Robb Engineering Co.

Carmen O'Dell, of Annapolis, N. S., is increasing his electric lighting plant by the addition of a 50 k.w. "S.K.C." Generator.

The Benallack Litho. & Printing Co., Montreal, has ordered from the Canadian General Electric Company, one of its latest type motors.

The Nelson, B. C., Electric Light Co. has sold out to the municipality for $35,400.

The Metropolitan Railway Company, Toronto, is now extending its line to Newmarket, Ont., which it is expected to reach by Nov. 1st.

The Hamilton smelting works will be fitted out with electric lights soon. The company will put in ten arc, and fifty incandescent lights.

The Canadian General Electric Co. has received an order from the corporation of New Westminster, B.C., for one of their 150 kilowatt monocyclic alternators.

The Hamilton Cotton Co., Hamilton, Ont., has decided to light its mills with electricity, and has placed an order with the Canadian General Electric Company for one of their 40-k.w. direct connected generators.

The West Kootenay Power & Light Company, Rossland, B.C., is rapidly extending its business, and for a recent extension has ordered from the Canadian General Electric Company three large feeder panels and two transformer panels.

The British Columbia Electric Railway Company of Vancouver, B. C., has found it necessary to increase its arc lighting plant, and has placed an order with the Canadian General Electric Company, for 1-125 light multiple brush arc dynamo.

R. H. Smith, Tilbury, Ont., whose plant was recently destroyed by fire, has placed an order with the Canadian General Electric Co., for an entirely new plant, consisting of two 15-k.w. standard Edison D. C. dynamos, and one 30-light arc machine. He expects to be running again in about two weeks.

The Kingston, Ont., Electrical Society has organized with these officers: C. Livingston, president; A. Chadwick, 1st vice-president; R. J. Dunlop, 2nd vice-president; R. H. Fair, Thomas Mills, D. E. Starr, John Carson, Joshua Knight, M. D. Curtis, G. McLean and Shibley, directors; Thomas Mills, treasurer, and J. P. Oram, secretary.

The Union Carbide Company, of Chicago, is arranging to greatly enlarge its plant at Sault Ste. Marie for the production of calcium carbide. The plant at Niagara Falls will be continued, but that at Appleton, Wis., will it is said, be discontinued. Twenty dynamos will be used in the new plant, and they have been purchased. These machines are single-phase, low-frequency alternators of 500 kilowatts each, delivering 2,500 amperes at 200 volts.

Herbert Webster, formerly of the firm of Webster and Hicks, Norwich, Ont., has secured a franchise for furnishing the town with electric light. The Canadian General Electric Company is supplying the entire electric equipment, which consists of a 700 light single phase alternator; marble panel switchboard, transformers, wiring. The corporation has contracted with Mr. Webster for the lighting of the streets by 40-32 c.p. incandescent lamps, operated in series.

The Montreal Cotton Co., of Valleyfield, P. Q., has placed a large increase order with the Canadian General Electric Company for induction motors, consisting of two 50-h.p., one 75-h.p., five 100-h.p. and one 200-h.p. When these are completed the cotton company will have one of the largest isolated electric power plants in America, the Canadian General Electric Company having already installed for this company, in generators and motors, a total of between 3,000 and 4,000 h.p.

The Canadian General Company has just closed a contract with the Lunenburg Gas Company, of Mahone Bay, N. S., for a 100 kilowatt three phase revolving field type alternating generator. This installation is to be used for the transmission of electric current, from a water power, situated about 9 miles from the town of Lunenburg, and will be operated without transformers at a potential of 4,000 volts. The company have also received an order for the wire to be used in the erection of the transmission line.

The amalgamation of the District Railway and Q. M. & C. Railway Companies is to be followed shortly, we understand, by the absorption into the joint concern of the Montmorency Electric Power Company. The shareholders of the Q. M. & C. Electric Railway Company will meet on the 13th inst. to ratify the bargain, and those of the Montmorency Electric Company a few days later. The trains of the Q. M. & C. will be run by electricity next year, and there will probably be an electric line along the Beauport road as far as Montmorency Falls.

L. E. Whitehead has resigned his position as superintendent of the Sherbrooke Street Railway.

The Peterboro Electric Light Co. is about to erect a modern power house at a cost of about $35,000.

The ratepayers of Barrie, Ont., have carried a by-law to raise $35,000 to build a municipal electric lighting plant.

An electric light system, arc and incandescent lights, has been installed by the C. P. R. at McAdam Junction, N. B.

Percy Domville has accepted the position of electrical expert for the city of Hamilton, Ont., in connection with the municipal lighting project.

A contract has been signed by the Canadian Niagara Power Company to supply light, heat and power to the Hospice of the Carmelite Fathers at Falls View.

A rumor is current that the Ottawa Street Railway Company has bought the Ottawa and Gatineau Valley Railway, and will convert it into an electric road.

As the people of Perth, Ont., defeated the Lanark County Electric Railway bonus by-law, there is now a scheme on hand to connect Lanark with Carleton Place.

S. C. Drummond, representing the British Electric Traction Co., of London, Eng., has applied to the Nelson, B. C., town council for a charter for an electric street railway.

There is talk of connecting the Niagara Central Railway with an electric road and extending it from St. Catharines to Port Dalhousie, Ont., and perhaps Beamsville, Ont.

L. E. Whitehead has resigned his position as superintendent of the Sherbrooke Street Railway. R. R. Smith, recently of Worcester, Mass., will assume the duties of superintendent.

A generator at the London, Ont., Electric Company's power house was burned out by the storm, Aug. 16th, and as a result power could not be supplied to a number of factories for a short time.

The ratepayers of Campbellford, Ont., have voted a by-law to raise $8,000 for the construction of a new incandescent light system over the entire village, to replace the one in use at present.

The Fisher Equipment Company of Chicago, manufactures electrically driven auto-cars, of which one known as a coach delivery wagon is now the property of the Robert Simpson Co., Toronto.

The Rat Portage Lumber Co. has fitted a motor to the car which supplies the planing mill and sash and door factory with lumber from the yards, and now has the first electric railway in Rat Portage, Ont.

The Jacques Cartier Pulp and Paper mill, Point Rouge, Que., has arranged to light the new pulp and paper mills by electricity. The order for the plant has been placed with the Royal Electric Co. and is to be installed immediately.

The Shawenegan Water and Power Company has advanced sufficiently with its plans for the installation of a plant capable of developing 100,000-h.p. to be enabled to call for tenders for the construction of the headrace, excavation for the wheel pits, etc.

The municipal ownership idea has apparently not swept Hamilton. A proposal to purchase the street railway has been rejected by the ratepayers by a vote of 264 to 2,043. Hamilton has at present an arrangement with its street railway that yields the city $16,000 a year. This coupled with the fact that only part of the voters were allowed to vote may account for the result.

A meeting of the shareholders of the Eastern Townships Light, Power and Carbide Co., was held at North Hatley, Que., a short time ago. The new company has been formed for supplying the electric light system to the villages of Waterville, Compton, Eustis, and North Hatley, and also to manufacture calcium carbide. The capital stock of the company is $50,000. At a subsequent meeting of the directors the following officers were elected: President, J. A. Gordon, North Hatley; vice-president, N. N. Walley, Sherbrooke; general manager, Dr. C. J. Edgar, Sherbrooke; secretary-treasurer, O. Roy, Montreal; assistant secretary-treasurer, Joseph Goodwin, North Hatley; solicitor, Mr. M. F. Hackett. The company has purchased the electric plant formerly owned by Edgar & Roy, and propose extending the business.

A charter for a railway to be operated by steam or electricity from Sault Ste. Marie to Michipicoten has been applied for.

The Stevens Mnfg. Co., London, Ont., has closed the electrical department of its business and will confine itself in future to agricultural machinery, etc.

The Royal Electric Co. is installing in the sub-station of the Cataract Power Co., on Victoria street, Hamilton, a 30-h.p. S. K. C. induction motor, which is to be used in driving the fans for the air blast transformers.

Electric light and gas fixtures are beautifully illustrated in catalogue No. 20 issued by Munderloh & Co., Montreal, wholesale electrical supplies and dealers in incandescent and arc light plants and electrical goods generally.

The Waterous Engine Works Co., Ltd., Brantford, Ont., is adding to its shop capacity, and requiring more power, is installing a 30-h.p. induction motor from the Royal Electric Co., which is to be operated from the alternating current lines of the Brantford Electric & Operating Co. This makes over a 100-h.p. in S. K. C. motors now operating in Brantford.

The Windsor Electric Light & Power Co., Windsor, N. S., is enlarging the recently installed electric lighting plant. It is adding one 100-k.w. and one 40-k.w. S. K. C. generator, with an additional complement of transformers and material. The S. K. C. apparatus and transformers are from the Royal Electric Co.

J. T. Ayers, of Lachute, has secured a franchise from that town to furnish incandescent electric lights. For this purpose he has placed his order with the Royal Electric Co., for a 100-k.w. S. K. C. generator, and the necessary transformers and material for the construction of the entire plant. The new plant will be driven by a water power situated about two miles from the center of the town.

The Ontario Telephone and Switchboard Construction Company, Ltd., has received an Ontario charter to manufacture telephones and other electrical appliances; capital $75,000. The incorporators are: R. Fox, T. H. Smallman, F. B. Leys, T. H. Purdom, R. A. Bayly, J. Labatt, M. Masuret, J. Milne, J. D. Wilson, M.D., and J. R. Minhinnick, London, Ont.; and R. H. Evans, H. C. Walters, Detroit, U. S.

The fourth of the 2,200-k.w. S. K. C. generators was set up in the Chambly Electric Manufacturing Co.'s power house at Richelieu, Que., a few days ago, and there are now ready for operation over 10,000-h.p. These are the largest electrical motors ever built in Canada, and the largest excepting Niagara Falls, that has ever been built. Electricity is no longer in its infancy, neither is Canada behind in the development of the science.

The Dundas Electric Light Co. has received a franchise from the town of Dundas, Ont., to furnish incandescent lights throughout the town, and also a contract for the street lighting. Both systems must be in operation by the first of November, 1898. The entire electrical equipment, consisting of a 50-k.w. S. K. C. two-phase generator, with 500 lights capacity in transformers, and all the necessary wire and material, is to be supplied by the Royal Electric Co., and the plant is to be installed at once. Geo. H. Harper, Dundas, will be manager of the new company.

Friday, the 26th August, 1898, will be memorable in the annals of electricity in Canada, being the day on which the Cataract Power Co., Hamilton, Ont., turned the first current on to the long distance transmission line between Decew Falls and Hamilton. The water was let into the fore bays and pipe line at about 3 p. m., and at 3.30 p. m. the hydraulic plant, consisting of two 1,500-h.p. waterwheels, and the electrical plant of two 1,000-k.w. S. K. C. generators, were turned over, the switch closed and the power sent to Hamilton, a distance of 35 miles, where it was utilized for lighting arc and incandescent lamps, and also for driving a 40-h. p. S. K. C. induction motor. The incandescent lamps in the sub-station, in Hamilton, were very artistically arranged in the form of a large star and maple leaf, and were kept lighted until far into the night. The plant will be started up permanently in a few days.

At the Royal Electric Company's fourteenth annual meeting the reports presented were considered to be satisfactory. The gross revenue was shown to have been $955,826; expenditure $636,057; interest and fixed charges, $42,609; net profit, $277,160. Four quarterly dividends have been declared, of two per cent each, equalling $120,000. Ninety thousand dollars was charged to profit and loss for reduction of assets in patents; $25,000 for depreciation of plant, and $31,992 for other reasons. It was shown that the company last year made eighteen and one-half per cent. on invested capital, as compared with sixteen and one-half per cent the preceding year. A dividend of eight per cent has been paid yearly since 1891. The company now employs 600 hands, and its wage bill exceeds a thousand dollars a day. There was expended in material last year $400,000. Business in new customers has increased fourteen per cent., and for lights, sixteen per cent. The addition of a new plant has resulted in an economy of coal consumption of 5,300 tons of coal; as compared with the figures of two years ago. The old board of directors were re-elected, namely: The Hon. J. R. Thibaudeau, president; D. Morrice, vice-president; F. L. Beique, Allan R. Macdonell, H. S. Holt, J. A. L. Strathy, A. Brunet, Edwin Hanson, Robert Cowans and W. H. Browne, general manager.

Personal

James Quigley, Kingston, has been appointed chief engineer of the Deaf and Dumb Institute, Belleville, Ont.

George Bottomly, aged 25, was killed recently by an emory wheel bursting in his father's mill, Halifax.

John White, for nearly a quarter of a century foreman in MacGregor, Gourlay Company's foundry, died in Galt, Ont., a short time ago.

James D. Banks, Toronto, formerly engineer on the steamer Ada Alice, committed suicide a short time ago by inhaling gas, and thus causing asphyxiation.

Louis Simpson, Belleville, Ont., an engineer on the Grand Trunk, was struck by the pilot engine in the Brockville yard, August 2nd, and instantly killed.

C. W. Taylor, vice-president and general manager of the Canada Carriage Co., Brockville, died last month, much to the regret of a large circle of friends.

F. R. F. Brown, late mechanical superintendent of the I. C. R., is said to have fallen heir to $50,000 through the death of a relative in England.

George Kelly was caught in a belt in the George Gillies Company belt factory at Gananoque, Ont., and was thrown over the shaft and instantly killed.

Dan. McAnnany, contractor, of St. Boniface, Manitoba, is dead from the result of an accident on the Crow's Nest railway construction, where he had a contract.

Frank Travers, a steam-fitter, was accidentally killed a short time ago at the Mimico asylum, while engaged in repairing the heating apparatus. A radiator fell upon him.

A. P. Coleman, geologist for the Ontario Government, has gone to England to attend the British association at Bristol. He will read a paper upon the inter-glacial period.

Hector McLean, president of the International Brick and Tile Company, died at Bridgetown, N.S., a short time ago. He was one of the best known men in Annapolis county.

W. Griffith, engineer at the electric light station, Carleton Place, Ont., has resigned his position to go firing on the Parry Sound Railway. J. Bennett succeeds Mr. Griffith, and Geo. Fife takes Mr. Bennett's place.

William Madden, Westville, N. S., who has held the position of deputy inspector of mines in Nova Scotia for many years, has been appointed, by the Dominion Government, one of the mining inspectors in the Yukon.

A. H. Harris, the late traffic manager of the Intercolonial Railway, has been appointed general traffic agent of the Fitchburg Railway Company, in charge of all traffic affairs in the Dominion, with headquarters at Montreal.

Percy Girouard, son of Hon. Mr. Justice Girouard, of the Supreme Court of Canada, has been appointed chief in the Egyptian railway system at a yearly salary of £2,000 sterling, by the Imperial Government.

James Hutcheon, city engineer, Guelph, Ont., was up some 50 feet in the old rolling mills to superintend the fixing of a block and tackle to take down railroad rails, when he caught hold of a loose board and fell to the floor below, but fortunately escaped serious injuries.

George Coates, son of John Coates, president of the Ottawa Gas Co., blew off his arm by the accidental discharge of a gun and died in a few hours. The accident happened at Shaganaga Lake, near Hunter's Island, Algoma. Mr. Coates was 21 years of age, and a student in the Kingston, Ont., School of Mines.

William Cooper, contractor of Clinton, Ont., fell about thirty feet from a scaffold on Aug. 17th, and died in about 20 minutes. Mr. Cooper was one of the best known men in the county of Huron and very highly respected. He leaves a widow and family, one of whom is John A. Cooper, editor of The Canadian Magazine and secretary of the Canadian Press Association.

Wm. Fraser, engine driver on the Springhill and Parrsboro Railway, was instantly killed at Springhill station, recently. He went under the locomotive to do some work and while under accidentally struck the brake with his hammer. The throttle of the engine had been left open, and the striking of the brake released the wheels of the engine, which gave a jump and went about eight feet along the track.

W. F. Robertson, the new provincial mineralogist of British Columbia, graduated in 1880 with honors in natural science from McGill. His first practical work was at the Capleton copper mines in Quebec province. He afterwards went to Pennsylvania as superintendent for the Chemical Copper Company, and next assistant in New Jersey to H. M. Howe at the Orford Copper Company. Mr. Robertson after this became superintendent to James Douglas' copper works at Phoenixville, Pennsylvania, and after some time there went back to the Orford Copper Company as engineer and put up their large works for that company, which, it may be mentioned, smelts the Sudbury nickel ore. Mr. Robertson later on was engaged as engineer of the Spring Hill collieries in Nova Scotia. He then went to Spain in the employ of the Minas Sotiel Coronada, and after returning to this continent put up a large smelter for the Osceola Smelting Company in the Lake Superior district, and had also charge of the smelting works at Great Falls for the B. & M. Co. Having gone back to the Orford Company as superintendent, he finally settled down in New York in private practice as a consulting mining engineer and has given reports on mines in various parts of the continent.

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

(Continued from last issue).

All buildings over 125 feet high should be provided with 4 inch, or, better still, 6 inch vertical pipes, with Siamese connections at the street, for the use of the fire department, extending to the roof, with hydrants at each story and on the roof. This would save the time of carrying hose to upper floors—a difficult task in the case of high buildings. Ample tanks of water should be provided on the roof, supported by protected iron beams resting on iron templates on the brick walls, to supply the building's inside pipe system for fire extinction, and secure pressure by gravity or by some other method constantly operative, especially on holidays and at night. Stone templates should not be used, and care should be taken to secure strong supports, so that, in the event of fire below, the tanks will not come crashing through the building to destroy it and endanger the lives of firemen. Two such disasters in "fire-proof" buildings within a year show how true is this proposition. Tanks in the basement, under air pressure are also a great advantage, and recent invention has perfected them to the point of reliability. Fire Marshal Swenie, of Chicago, urges that standpipes should not be less than 6 inches internal diameter, and that a check valve should be provided, so that when steamers are attached, their force will be added to that of the local pumps. Each floor should have hose connections with the standpipes, and sufficient hose to reach to the most remote point of the floor above, and this hose should be frequently inspected to see that it is in order. He recommends that a code of signals, by which communication can be established between the firemen and the engineer of the building, is essential.

All high buildings should have constantly present, night and day, some competent person understanding the elevator machinery, fire appliances, etc., so as to aid the firemen in reaching the upper levels; and there should be sufficient steam in the boilers, at all times, to run one elevator.

Marble, slate, and other stones are certain to disintegrate or crumble when subjected to the joint action of heat and water. For this reason 90 per cent. of the staircases in modern "fire-proof" buildings would be found utterly unreliable in the event of fire, either for the escape of the inmates or for the use of firemen—a serious consideration. Stone treads are usually let into iron rabbet frames, and as these stone treads would give way in case of fire, it would be impossible for a person to find a footing on the stairways; 2 inch oak treads might actually last longer; but a safer staircase would be one the framework of which is of iron, the tread having an iron web or gridiron pattern, the interstices or openings of which should be small enough to prevent the passage of a foot, underlying the stone or slate, so that if the stone tread should disintegrate, the staircase still remains passable. It is possible to have the supporting tread of open work cast iron in an ornamental pattern, which, in relief against the white marble tread resting on it, would present a tasteful appearance from the underside or soffit of the staircase, with this great advantage, that in the event the action of fire and water should pulverize the marble or slate tread, it would still afford a safe support for the foot. It is generally supposed that it is not necessary to be careful as to stone treads in buildings occupied solely for offices separated in "fire-proof" hallways in which, it is claimed, there is nothing to burn; but in the case of one large "fire-proof" building of this kind in New York, I found the space under the staircase in the basement story was used to store the waste paper rubbish of the building—material particularly likely to cause a fire by concealed matches, oily waste, cigar or cigarette stumps, etc., and to make a lively and quick fire, quite sufficient to destroy stone staircase treads. Even where there is no combustible material in the hallway, if the staircase is near windows, stone treads may be destroyed by exposure to burning buildings and by the combustion of window frames, dadoes, and other wooden trim.

No building should exceed in height the width of the street on which it is located, from the view point of light and health; nor, in any case, in excess of 95 feet for mercantile occupancy, nor a height in excess of 200 feet for office occupancy.

It should be remembered that merchandise, furniture, etc., are combustible, no matter whether located in "fire-proof" buildings or in ordinary buildings. This obvious fact seems generally to be ignored. In fact, combustible material will sometimes be more effectually and thoroughly destroyed in a "fire-proof" building than in an ordinary building, since the early collapse of the latter may smother the fire and effect salvage, whereas "fire-proof" floors support the contents of the former, and distribute them so that they are more certain to be destroyed.

Enclosing walls should be of brick, the brickwork of the lower stories especially, if not of all, being laid in cement mortar. In fact, the specifications for a building in the compact part of the mercantile section of a city, ought to be drawn in contemplation of the possible cremation of its contents, and the generation of heat considerably greater than 2,000 degs. Fahr. The heat of a wood fire is from 800 to 1,140 degs.; charcoal, about 2,200 degs.; coal, about 2,400 degs. Cast iron will melt at between 1,900 and 2,800 degs.; wrought iron, 3,000 to 3,500 degs.; steel, 2,400 to 2,600 degs.; and if an architect should be required to draw specifications for a building adjoining others, with the knowledge beforehand that its entire contents, from cellar to roof, were to be totally consumed, and he were under a bond to pay damages to surrounding property, he would not be more severe in his exactions than should a building law protecting neighborhood rights in the enjoyment of property; for a mercantile or manufacturing building sometimes generates a greater heat in combustion than a smelting furnace. It is hardly necesary to deal with the foundations of buildings. The question is an engineering problem which hardly requires suggestions from a fire standpoint, and I shall not deal with it here, other than to touch again upon the important point of not having wrought-iron or steel columns in the cellar or basement, where moisture and gas conditions would increase the danger of rust. These, as already stated, should be of brick, the lower stories laid in cement mortar, not less than 16 inches thick at the top of the building and increasing 4 inches in thickness for every 25 feet in height to the bottom. This would require a 44 inch wall at the grade for a 200 foot building. The thicknesses here recommended are for buildings not exceeding 100 feet in depth. If they exceed this depth without curtain or cross walls, or proper piers or buttresses, the walls should be increased in thickness 4 inches for every additional 100 feet in length.

Brick is the best known resistant of fire. Stone yields readily to the combined effect of heat and water, and even terra-cotta or burned clay tile cannot be regarded as a perfect substitute for hard-burned brick. Under no circumstances should the iron framework of a skeleton building be incorporated in thin enclosing walls. No wall that has not a cross section sufficient to support itself without the ironwork should be allowed, aside from the importance of having it thick enough to prevent the passage of hot air from an adjoining building. Curtain walls for enclosing walls supported by the longitudinal members of skeleton construction are objectionable; they are liable to be buckled out by the expansion of the framework. The great trouble with modern "fire-proof" structures is, that while the separating "fire-proof" floors tend to prevent the passage of flame from one story to another, the enclosing walls are often insufficient to prevent heat from igniting the contents of an adjoining building, so that what is gained by preventing the spread of fire vertically is lost laterally. It should be borne in mind that the thickness of walls herein recommended is not for carrying capacity as bearing walls. Thinner walls would answer for that purpose. It is intended to confine the heat generated by a fire, and should be required in the compact portions of cities, where every man should be compelled to build with reference to the safety of his neighbor.

Architects and builders generally seem to have in mind only the carrying capacity of walls, and to lose sight of this important fact. As the contents of a mercantile building and its floors burn, they sink to the bottom, where enormously high temperatures are reached, and it is for this reason recommended that walls should increase in thickness as they approach the bottom, on the same principle that the walls of smelting furnaces are thicker at the bottom than at the top. It is the generally accepted opinion that a 12 inch brick wall will prevent the passage of fire, but a much thicker wall will fail to confine the heat of a burning building on the first floor particularly, sufficiently to prevent the ignition of combustible merchandise or other material in an adjoining building. In a fire which occurred in Boston, several years ago, combustible material was ignited through a 3 foot wall, which became so hot as to thus conduct the heat into the adjoining building.

I do not believe "skeleton construction" so-called should be permitted for stores, warehouses, or manufactories in cities, as the walls are not thick enough to confine the heat of burning merchandise. In some of our Western cities, Detroit, Chicago, etc., the practice is growing of using hollow tiling, bonded like ordinary brickwork, 12 inches thick, for enclosing walls, instead of brick, the exposed steel frame being protected by terra-cotta slabs about an inch thick. The Leonard building, in Detroit, destroyed by fire October 7, 1897, was an example of the great danger of this style of construction. It was ten stories high, and as fast as the columns or wall girders were warped by the heat the tiling dropped out like loose bricks, leaving the entire structure after the fire a ragged cage-work of iron with very little of the tiling on the enclosing walls and none of the floors intact. The contents were, of course, totally destroyed.

Bond stones should not be allowed in piers, especially in the cellar or basement, or in piers vital to the building or carrying great weights. Stone yields readily and quickly to the combined effects of water and heat and, disintegrating at its edges, gradually releases the bricks above it, so as in time to destroy the integrity of the pier. Bond stones are employed by the mason to steady his work. A green brick pier while being laid is frequently unsteady, and a bond stone enables him to progress with his work by steadying all below it so as to receive new courses of brick. In all cases the bond should be a cast-iron plate. If the plate should be cast with holes through it about 1½ inches in diameter, so that the mortar and cement can thoroughly incorporate the plate with the masonry above and below, it would be an improvement. Wrought iron is liable to rust and should not be used. Where bond stones are used in the outer walls of buildings they are less objectionable, but for inside piers they are so dangerous that they ought to be prohibited by law. It not infrequently happens that a building of otherwise admirable construction has its weakest point in the cellar, where a stone pillar forms the basis of support of the entire line of columns through the building. In case of fire and the application of water these stone pillars, no matter how substantial, whether single monoliths or stone blocks, will rapidly disintegrate and bring down the entire structure; and inspectors should carefully examine, especially in the cellars, for such construction. After the great Boston fire, granite piers were shovelled up and carted away like so much sand. It is quite a common practice, but a most dangerous one, to employ single stone columns, often of polished granite, to support the centre of a long stone lintel carrying the wall over the ornamental entrance of a building. Such a column would surely yield to the effect of fire and water and perhaps let down the entire front. The vertical supports, columns, pillars, etc., as already stated, should be of cast iron, cylindrical in form, of liberal thickness, especially in the lower stories, thoroughly tested as to sand holes, thin places, etc. Cast iron columns should be round, and not square. In the former shape there is less likelihood of defects in casting, sand holes, etc, resulting in uniform sound thickness of the shell. The columns should be planed to smooth bearings, so that the entire system of columns, from the foundation to the roof, may be securely bolted together and form a continuous line with joints for expansion and without any inequalities of bearings. Under no circumstances should wedges or "shims"* be allowed. This most important matter is often neglected. The flanges and corbel brackets for supporting beams should be cast in one piece with the column and not depend upon rivets or bolts. Rivets, aside from the danger of shearing strains, are almost certain to rust to the point of danger. The beams should be riveted or bolted to lugs on the columns, however, as a tie between the side walls, holding the entire structure firmly and consistently together as one rigid whole and yet with play for expansion. Col. George B. Post, of New York, has devised a form of cast-iron cage construction consisting of pillars and floor beams, the members of which lock into each other without the use of bolts or rivets, forming a very rigid construction, and saving the cost of mechanics for bolt and rivet work.

(Continued in next issue)

—Gaseous fuel as a substitute for the direct consumption of coal continues to extend in England, state Matheson & Grant in a recent circular to the engineering trades. Not only are the waste gases of blast furnaces being more skilfully utilized than heretofore, but improvements and economies in the making of producer-gas from cheap waste coal at the collieries, encourages its use as power for gas engines, and in some cases as fuel for steam boilers. This change, if it continues to extend, will go far to solve the question of smoke prevention in iron manufacturing towns.

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*Shims are pieces of slate or iron inserted to secure a true vertical, where the two surfaces have not been properly levelled or planed.

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PURIFICATION OF SEWAGE BY IRRIGATION.

BY W. M. WATSON.

There is a good deal of misconception with reference to sewage purification by irrigation. It appears natural to convey all filth and manure to the land from whence it came, and make the cycle of production and consumption complete, and probably on this ground the many scientists and public officials favor irrigation. But experience and discovery have shown that land can only act as a filter, that is, a place for the lodgment of micro-organisms, that live and do the work of cleaning the dirt from the sewage, thus bringing the fluid back to its former state of purity. To enable the microbes to do this, that able scientist, W. E. Adeney, proves that air must be supplied and properly distributed to every separate atom of sewage in the proportion of three parts of air to one of sewage. Air cannot possibly be distributed into all the particles of the soil of a farm or any other land to a greater depth than about one foot, and often less, and when sodden with water or snow very little if any atmosphere can penetrate. Many inventions are being tried to aerate even artificially made filters. The best yet known is to fill the filter quickly, allow it to stand for a given period, then slowly draw the fluid off. As the fluid settles from the filtrate air is drawn into the interstices between the small cubes the filter is filled with, in that way the micro-organisms secure sufficient oxygen to give them vitality. By another method porous pipes are placed among the small cubes of coal, coke, clinkers, or whatever material may be used to filter or separate the particles of sewage fluid and atmospheric air passed through them at a pressure of about four inches of water by a fan, so that a constant supply of air is conveyed to the interior of the filter and is distributed throughout during the time the sewage is passing through, and on that account the filters work continuously. It is obvious that land that cannot secure air except at the surface, therefore cannot form a lodgment for microbes that must have air to live. If there are no microbes then there is no purification, and a milk sieve would do just as good work as any land, or even any artificial filter that cannot be supplied with air by some process or its equivalent (as some claim) of soda or similar chemicals. Arthur Turley, C.E., inspector of English sewage disposal works, states on page 5 of his report for 1890, that where irrigation is adopted, either alone or in combination with some precipitating process, the foreign matter in solution in the sewage is frequently increased by salts washed out from the soil. German chemists have given much attention to this disadvantage attendant on land filtration. The Teltower Sea, a lake near Berlin, was fouled by the effluent from the noted Berlin sewage irrigation works. Professor Muller reports that during nearly six months of the year no vegetation takes place on the land, and in hard frosty weather the land will not act properly, and the sewage must be stored up in tanks. Dry earth exerts a strong purifying influence on fœcal matter, but has very little if any effect on the other ingredients contained in sewage which contain millions of dangerous bacteria. People go into ecstacies if they see a sewage irrigation land that appears to perform its work well, as they usually do for one year, and sometimes as much as four years, and the success is proclaimed far and wide.

It came to my knowledge that a sewage farm near Montreal was considered to be very near perfection, and on September 14th last I had the privilege of inspecting this farm at St. Lawrent College, St. Lawrent, a village near Montreal. The farm contained $1\frac{1}{4}$ acre or 6,000 square yards of land, raised by light soil to a level of over 20 inches above the natural ground line. The population served by this irrigation system was said to be 400 persons, the daily sewage was about 4,500 gallons, an average of $11\frac{1}{4}$ gallons per head, which would allow the very small amount of only three quarts of sewage to one square yard of land per day. This system cannot properly be called a sewage farm, it is really the land filtration system, because the soil is well underdrained by having a row of land tile pipes laid under the centre of each of the twelve bays or divisions which deliver the effluent after the sewage has passed through the land into the parish drain, this coupled with the fact that the land was raised with light porous soil makes it an artificial land filter. The surface appearance of the land is that of a checker board having twelve trenches cut across from the distributing channel to the opposite side and to cross trenches, each trench being about 15 inches deep. The irrigation land and necessary appliances were said to have cost $3,500, or an average of $8.75 per head of population. This is exclusive of the sewage storage and collecting tank and the steam pump. This is a high price to pay for a system of sewage purification that can't possibly work efficiently during hard frosty weather, and that gives off a disagreeable and unhealthy odor each time the sewage is run onto the land.

The engine and pump send each day's collection onto the irrigation land in the space of about two hours, so that the land gets only two hours' work and 22 hours' rest and aeration daily, and it may also be observed that the small amount of only ¾ of a gallon of sewage to one square yard of land cannot make any serious effect on the light soil, and it will be quickly absorbed during the hot dry weather of summer. If it was possible for each town to secure a light porous land, well underdrained, and to allow their irrigation filters 22 hours' aeration each day, a bright, pure effluent would be the result for several years until the porous soil got fatty.

But not one town in ten can secure suitable land for sewage purification works, and if the land has to be properly prepared and underdrained so that it cannot possibly become waterlogged, then the cost is so high as to be prohibitive, because artificial tank filters can be built at about the same price that will do fifty times the amount of work, and work efficiently both summer and winter. It is next to impossible to efficiently aerate irrigation lands, and on that account they gradually become sick and clogged with injurious microbes, therefore, in time, they become utterly useless as did the irrigation system adopted at Berlin, Germany.

A week prior to inspecting St. Lawrent sewage works I was engaged to go to the Georgian Bay district and find out why a sewage works had become totally disabled and was discharging foul odors. This irrigation filter is very similar to the St. Lawrent one, but with more advantages, because it is built on high ground and can be clearly drained to a depth of over four feet.

The whole filter at the Georgian Bay was created by piling up gravel and sand inside of a wooden fence. It is only used in the four hottest months of the year, that is during the tourist season. The population using the irrigation filter when the place is full with guests is under 300, including servants. The size of this irrigation land is 80 by 45 feet, which is ample to purify the sewage discharged when the fact is taken into account that all the solid matter contained in the sewage is supposed to be extracted by settling tanks prior to to its being discharged over the irrigation filter, on the intermittent system of working 30 minutes and resting three hours, and at the rate of only 10 gallons per yard per day when working at the fullest capacity.

After working for only two months the pores of the filter got so clogged that no sewage would pass through it, the cause being that the sheet iron settling tanks were not large enough to give sufficient time for the solids to separate from the liquids and to prevent the manureal matter from passing over on to the irrigation filter, and when a filter becomes badly clogged or sick it is impossible to clean it except by putting the whole of the filtrate through a furnace, and bringing it to a red heat, or by turning it all over with a hand spade and spreading it out in thin layers exposed to the purifying influence of the air for a year.

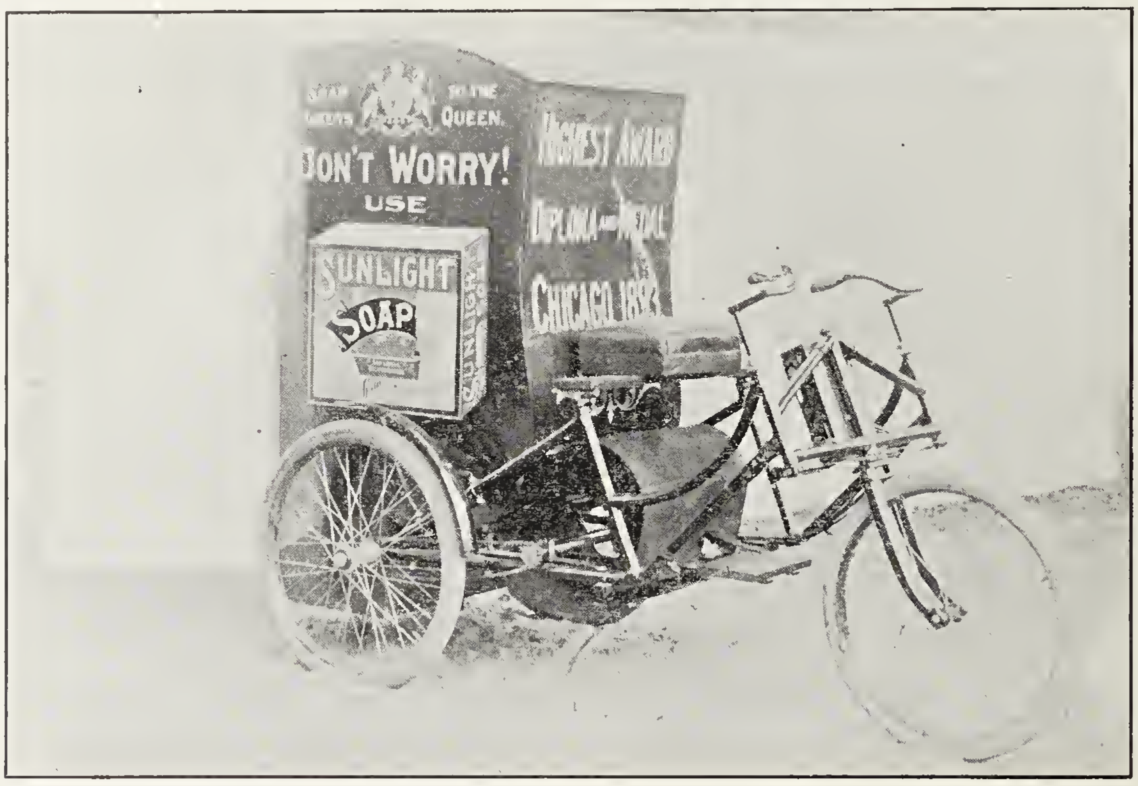
The apparent success of the St. Laurent sewage works is delusive, for like all other similar irrigation works the soil will in time become sick and clogged, and proof is already to hand, for we were told that during this summer the underdrains have not collected any effluent, yet that during the corresponding period of last summer they did collect considerable, so the bottom and heavy portion of the irrigation land is already sick, and the sickness will grow until the light porous soil at the top is also contaminated. It must come to that state, because land will not continue to purify sewage unless it can be often and thoroughly aerated to the level of the underdrains, which is very difficult. Much stress was put on the fact that the crops grown on the land were abundant and proved the system a paying one, but if such light soil had got watered by clean rainwater of the same amount as the sewage supply the crops would have been equally abundant, and certainly more wholesome. That eminent medical authority, A. Parks, adviser to the British Government, in his book on Hygiene, written for the benefit of the British army, states that plants grown on land irrigated by raw sewage are unsafe to eat (see page 354). On pages 119 and 121 he proves that the atmosphere near all sewage irrigation farms is impure, and people living near are subject to enteric fever and other disorders, so that the surrounding land always must decrease in value.

THE MOTOR CARRIAGE INDUSTRY.

It is with satisfaction that we note the present condition of the motor carriage industry, as the business seems to have passed the dangerous stages. The period of booming is passing, and after an enormous expenditure of capital in valueless patents, unsound companies and empty advertising, autocar makers are acting upon ordinary business principles. France takes the lead, and already there is invested in the autocar business in that country the enormous sum of $150,000,000, while 2,000 men are constantly employed in the industry. This condition of affairs is due to two causes: First, the magnificent roadways in France, and secondly, the fact that the French peasantry are very hard-working and extremely frugal, and thus have an immense sum total of money always in reserve to invest in enterprises that have the virtue of novelty as well as the promise of success. Added to this is the fact that the leaders of French society have taken very kindly to the new pastime of "motoring," and large sums from private fortunes are being lavished upon the manufacture of motor-cars of all descriptions. The Count de Dion deserves special mention in this connection. Twelve years ago he prophesied the wonderful development we are now witnessing in horseless carriages; and during all these years he has lavishly spent time, thought and treasure in supporting the inventive genius of his mechanical associate, M. Bouton. It is satisfactory to note that the daring and dashing enterprise of the rich Frenchmen are being rewarded by enormous business returns. One firm, Panhard et Levassor, in a single month recently took orders for autocars amounting to a quarter of a million dollars. M. Frankel, who designed a small tricycle carriage to sell at $400, in less than a month took orders for $40,000 worth. All the autocar shops in France are so crowded with orders that customers have to wait from six to fifteen months for their carriages. These factories are in nearly every case huge establishments employing several hundreds of men.

There is some activity in Germany and Belgium, but nothing is being done worthy of special mention. Crossing over to the British Isles there is a perceptible improvement in the autocar industry there. True, the hand of the promoter is visible in many of the schemes that are being exploited, and a great deal of experimentation is still being done; yet in various parts of England, especially in Coventry, and also in Scotland, praiseworthy efforts are being made to get the business down to a commercial basis. The Daimler Motor Company, which works under the patents of a German inventor, seems to be taking the lead, but they have had some trouble recently in connection with a complaint by Henry Sturmey, the editor of The Autocar, in reference to the election of a novice as chairman of the board. The result has been the appointing of an investigating committee of three able persons, whose efforts, it is hoped, will result in good to the shareholders and the industry. Her Majesty's mails are being carried in some places by motor vans. The recent trials of heavy haulage autocars in Liverpool were a failure so far as new methods of propulsion are concerned, there being no entries of electric or hydro-carbon systems, and the steam vans, while showing structural improvements upon those of sixty years ago, have not yet overcome some of the inherent difficulties. In a recent issue we gave a full outline of the Liverpool trials. An American engineer, Hugh Dolnar, makes some caustic and critical comments on the exhibition, and it may be interesting to quote some of his conclusions. In an article in the Cycle Age, he says: "Such were the actual results of the Liverpool trial, the wagons in the hands of their builders showing that they had power enough to pull the loads over a bad road, it is true, but that otherwise they were wholly unsuited to any existing conditions of transportation now performed by the aid of horses. . . . . The heavy, self-driven wagon has not been built yet. It will be built, but no such absurd assertions that failure is success as are contained in the Automotor's silly editorial will make it come a day sooner. The situation calls for a calm consideration of facts and results obtained. In all mechanical operations the quickest way out is to recognize failures, and so be in a position to look for elements better adapted to meet actual conditions. None of these wagons shown at the Liverpool trial could do anything whatever towards city trucking, and it does not seem at all likely that any steam engine driven wagon will ever be found suitable for heavy work, loads of say from two to four tons, such as are commonly drawn on two-horse trucks. The heavy truck is a far more difficult problem than the four or six-passenger vehicle, and absolutely must have all four of its wheels driven, and must be able to place itself as quickly as a horse-drawn vehicle can be placed at the curb or on a crowded pier." In London the electric cabs are only partially successful. Recently there was a strike among the drivers, and one of them stated their grievances to be: numerous break-downs of the mechanism, for which the drivers had to pay although they were not liable; the slow speed of the cabs, thus reducing the drivers' margins; poor pay as compared with that allowed drivers of horse cabs. The matter was patched up after a few days by concessions from the company. The London electric omnibuses are not yet running. The real reason for this, as well as for the trouble with the electric cabs, we believe to be the lack of storage batteries that while lighter than those now in use will yet give off more power. The immense dead weight carried by the London omnibuses, each of whose batteries weigh about 1,600 lbs., adds enormously to the perplexities of the problem, and it is safe to say that until a lighter battery equipment is provided the solution will be far off.

In the United States the industry has made very little headway. As the editor of The Cosmopolitan—who two or three years ago gave a prize of $3,000 for the encouragement of the industry in the United States—remarked in an article published in his magazine last month, it is astounding that a people so progressive as the Americans should be so far behind France, and indeed England, in this industry. One explanation of this backwardness is found in the fact that the American roads are about as bad as they can be. Worby Beaumont, the president of the Society of Engineers of England, remarked to the editor of The Horseless Age, when on a visit to New York recently, that the American roads were the worst in the world, and he could quite understand why the horseless carriage industry had not made further progress there. Col. Pope, of bicycle fame, has spent nearly a quarter of a million dollars in exploiting electric equipment for carriages, and from his motor vehicle factory in Hartford has turned out several of the Pope carriages. Their price is $3,000, their weight about 2,500 lbs., and their carrying capacity only two persons, their running power only about 25 miles; and these limitations and conditions have prevented ready or rapid sale. Col. Pope is now exploiting gasolene with Hiram Maxim at the head of that department. So far, however, nothing striking has been produced. The Duryea motor carriage, of which so much was expected, has sunk into comparative insignificance. This carriage won about $8,000 in prizes at various races; but attempts to establish companies for its manufacture in New York and in Canada have proved failures, and the sample carriage which was sent to New York under option to capitalists there has been returned to the shops in Springfield. This gasolene carriage is of reasonable weight and speed, though the efficiency of the engine is not great.

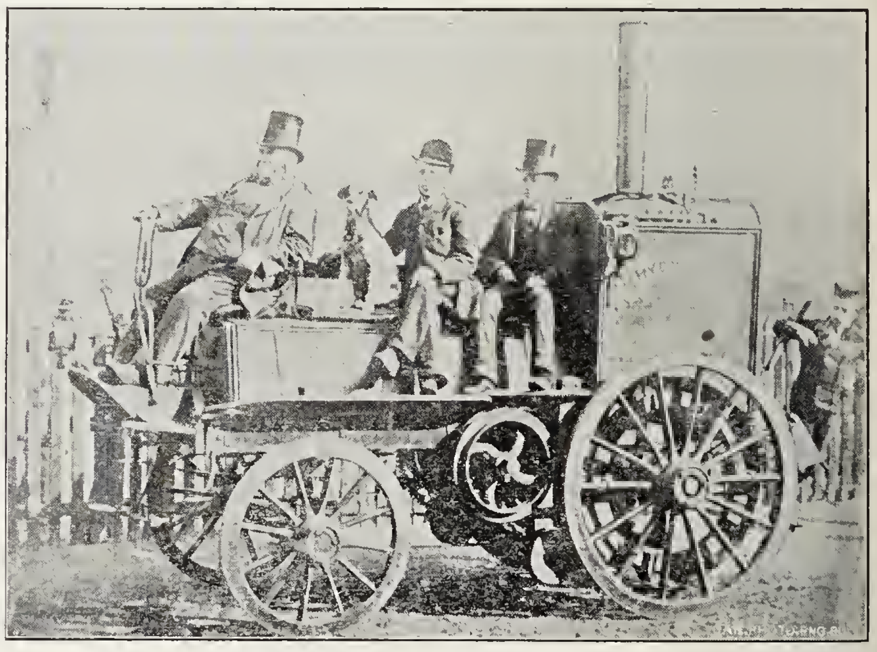


The Winton gasolene carriage of Cleveland is now taking the lead, yet only fifteen of these have been sold to date. Mr. Winton, who is a bicycle manufacturer, has been working for about five years on his gasolene engine, and has produced a creditable carriage, two of which have found purchasers in Canada in the Messrs. Moody, of Hamilton. The carriages sell at $1,000, carry two persons, weigh about 2,300 lbs., and show good speed and efficiency; but there is nothing radical in the construction of the engine.

The Electric Vehicle Company of New York is pushing the introduction of electric cabs with great energy and spirit. An interesting illustrated description of their battery system was published in the September number of the American Electrician. They certainly deserve success, yet their cabs while carrying only two passengers in addition to the motorman, are so heavy that they represent over 1,000 lbs. per passenger, and this enormous dead weight requires the construction of special wheels made of cast-iron mounted upon pneumatic tires. The cabs, however, are popular, and if once brought down to a commercial basis could be made a highly profitable business. A correspondent recently drew attention to the enormous field for motor carriages in California, where alfalfa hay is dear, and yet has to be transported with the caravans in order to feed the immense number of horses needed. It is usual to hitch up twelve horses to a single wagon, and yet with this enormous hauling power only twenty or thirty miles per day can be made. So far there has been no attempt made in the United States to develop the haulage of heavy traffic by autocars. There is to be an exhibition of motor carriages in Boston this month and next in connection with the 20th Triennial Exposition of the Mechanic Association, and prizes are to be offered in connection with motor carriage races, but nothing definite has yet been announced.

The steam carriage shown in the accompanying illustration was built in Birmingham, England, in 1870, by J. & W. R. Inshaw, now of New Bedford, Mass. The brothers were then in partnership with their father in the engineering trade. This carriage held ten passengers, not including the steersman and the boy who acted as stoker. The gross weight when loaded with water and coke was 3,000 pounds. There were two tanks for carrying water, which was introduced into the boiler with a force pump and injector; the tanks held sufficient for a two hours' run. The boiler, which was of the watertube type, steamed very rapidly, and steam could be raised to 100 pounds pressure in $1\frac{1}{2}$ minutes from cold water. The engines consisted of a pair of long-stroke engines, with cylinders having a diameter of three inches and a stroke of 12 inches. These drove an intermediate shaft which had a clutch arrangement, and the power was carried by means of a chain. From Coventry to Birmingham (eighteen miles) in one hour is the best work this carriage has done when carrying its full complement of passengers.

We speak of Canada last. The Canadian Motor Syndicate has recently begun the manufacture of storage batteries on the Still Battery System, and have already equipped two types of vehicles (shown in the illustrations), one an advertising tricycle having a speed of ten miles per hour and a capacity of twenty miles without recharging, the battery weighing 150 lbs., and carrying in addition to the driver a load of 250 lbs.; and a Victoria seating four persons, having a speed of fourteen miles per hour, a capacity of thirty to thirty-five miles without recharging and a battery weight of 350 lbs., the total weight of carriage being 800 lbs. As compared with the American and English, these Canadian electric carriages and their batteries weigh only about one-fourth, and yet are claimed to possess equal if not greater efficiency. The finishing touches are being put upon a new gasolene engine of Mr. Still's invention, to which reference was made in the illustrated article in THE CANADIAN ENGINEER of April last.



GARBAGE DISPOSAL IN MONTREAL.

BY W. M. WATSON.

Lately I visited and inspected the garbage incinerators in Montreal, which I was told cost $45,000. They have twelve furnace grates, six on each side of the main flue. The fire, places are about six feet wide each, and sixteen feet from front to rear, and have each two clinkering doors. The grate bars form a steep incline, and appear to be six feet higher at the rear than at the front doors, and terminate at the rear end—with a short shaft passing up to the floor line of the tipping floor—through which the refuse is passed down to the fire bars. Each furnace will hold about three tons, and they are apparently only charged two or three times each day. When first built they had a boiler which raised steam from the wasted heat (or should have done so), and steam blowers were supplied to increase the draught, and raise the temperature of the furnaces. But all such appliances have been taken off the apparatus; probably the men appointed to manage the works did not know the value of the appliances, and could not work them to advantage. There is also an extra furnace in the chimney flue that was placed there for the purpose of burning the fumes discharged from the furnaces prior to passing up the chimney and out into the atmosphere, but this is not used and no pretence is made of consuming the foul smelling gases passing up the chimney or to prevent the dust from escaping.

The fires are of course kept at a low temperature, and the ashes and clinker taken from the furnaces are of a soft nature and of little value for use on public works, though if a high temperature incinerator were near the clinker might be reburnt and made hard enough to use for roads, concrete, etc. The heat from the twelve fires is all wasted, showing how rich Montreal is. If the same amount of rubbish was burnt in England they would make profitable incomes from the heat coming from the fires from the many things of value that come mixed with the garbage, and also from the clinker that was drawn from the furnaces. But the British public authorities cannot afford to waste valuable products, they turn even their garbage into cash. There is a fine long chimney and large, straight flue running between the fires, having main and local dampers, so that the draughts can be wholly or locally cut off from each fire separately. There is also an incline road and tipping floor that covers all the fires and flues, well housed and roofed in. The garbage is chiefly vegetables, fish, meats, and light refuse, together with dead animals.

These incinerators are an improvement on the Toronto crematories, but even then they are a long way behind the garbage destroyers used in Europe, both from a sanitary and financial standpoint. As soon as some public authority has the pluck to have a first-class destructor erected and afterwards intelligently managed, the advantages over the present kind will be so apparent that Canada will see the last of the wasteful incinerators now in use.

—Toronto is about to make an experiment aiming at retaining trade in the eastern portion of the city by building a large hotel. The site chosen is one on King st. east, which has been left vacant by the failure of a large dry goods store. The promoters are not able, so far as we know, to point to a single instance in which it has been possible to alter the course of trade when once in motion toward the west. The new city hall and the large office buildings which have been built in the past couple of years to the north and west of the proposed site will have a much greater inflence in drawing business towards them than will an hotel, even if the hotel succeeds, which upon the face of it is in the present case unlikely. To succeed it would require to attract tourists and to hold largely the local restaurant trade of the best class. The proposed site is away from the theatres, the fashionable promenades, the railway stations, the large departmental stores, from everthing that should be near at hand, and is in addition hot and unpleasant in summer, thus rendering a tourist trade impossible.

—There may be too much interference on the part of the Government with private interests, and we are accustomed on this continent to look with suspicion on Government regulations of any sort, but we are beginning to see more clearly the necessity of Government inspection of all works which are likely through defect to cause danger to public life or health. Liability of the owner to make good damages resulting from defective construction is not the safeguard in America that it has been found to be in England. Sometimes here the owner is a great corporation or controls a large local influence and investigation is burked. In the United States this is a usual, in Canada an exceptional circumstance. An example of what might have been a serious accident was recently brought to our notice. A high chimney for a large power-house had its foundation put in on a site where the nature of the soil and the work done made its collapse a certainty. Fortunately an engineer who happened to examine the work called the attention of the owners to the matter, the structure was taken down and a suitable foundation put in. In advance of an official report on the subject it is impossible to state the cause of the collapse of the O. & N. Y. railway bridge at Cornwall, Ont., described in another column. Had there been an efficient Government inspection of the work done on all railway bridges in and adjoining Canada we would have had on file the records of the borings made to locate the piers in the first place and a statement of the manner in which the concrete in the pier hardened as it was put in. With this and other data the public would be much more fully informed, and if these facts were published during the construction of the work many believe that the accident would never have taken place. Publicity in these matters is a good thing

A SHORT HISTORY OF SEWAGE DISPOSAL AT THE ASYLUM FOR THE INSANE, LONDON, ONTARIO.*

BY R. M. BUCKE, M.D.

London asylum was ready for the reception of inmates in the autumn of 1870, and by the end of that official year 457 patients had been admitted chiefly from the Malden and Orillia branch asylums, which were thereupon closed. The sewage of the new asylum was thrown into a small creek three miles above the opening of the same into the south branch of the Thames, the said opening being three miles above the city of London. Every summer the creek became nearly or quite dry, and it was not very long before the farmers and others who lived along its course complained bitterly of the nuisance caused by the asylum sewage. Complaints and threatened prosecution were met by the establishment of a charcoal and gravel filter at the lowest point of the asylum land. The said filter was operated intermittently with more or less (chiefly less) success for some fifteen years. It would do its work fairly well when fresh charged: but it proved impossible, by any reasonable expenditure of labor and charcoal to keep it in a state of continuous efficiency. The protests of the property holders along the creek, which had been partially silenced by the establishment of the filter, broke out anew and were naturally intensified by certain cases of typhoid fever, which occurred among them. It became clear that some more radical remedy for the evil would have to be adopted, and it was finally decided to adopt that method of sewage disposal which goes by the name of Intermittent Downward Filtration.

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*A paper read before the Ontario Association of Executive Health Officers, at the Ottawa Convention.

A piece of sandy land, four acres in extent, was selected for the purpose. This, in the first place, was graded perfectly flat, and was then laid out in alternate beds and trenches; the beds being ten feet and the trenches eight feet wide. The difference in level between the surface of the beds and the bottom of the trenches is twenty inches. The length of the beds and trenches is 220 yards. The number of the trenches is eighteen. The whole plot was provided with an elaborate system of tile drainage, many thousand feet of two inch tile being used. These were supposed to carry the purified water of the sewage to a well situated at the southwest corner of the field, which well was expected to overflow into a surface drain, and its water to run to the head of an adjacent small creek. Experience showed, however, that this tile drainage was almost or quite unnecessary and useless. Of late years the tiles have been dug up here and there for the purpose of examination, and it has been found that no water ever passed into them—they were in precisely the same state as when they were put down—that is, they were apparently quite new and unused. In one part of the field, however, in which the soil is not so sandy, some water does pass into the tile in wet seasons. On the whole, however, water seldom runs into the well, and I have no doubt the field would do its work as well without the tile as with it.

The sewage field is on a slightly higher level than that on which the asylum itself stands; it is therefore necessary to use a pump. The sewage from all parts of the institution (including of course, all laundry and other impure water), is run into an underground tank 80 feet long, 40 feet wide and 15 feet deep. From this tank it is thrown once a day by a centrifugal pump through a six inch iron duct into a small well at the northeast angle of the sewage field. This well, after being filled, overflows into a long trough made of three two inch planks spiked together. Opposite each trench there is a short spout made with similar two inch plankings. Each spout is fitted with a sliding gate and just beyond each spout the trough is fitted with a similar gate. By means of these gates the sewage is turned into any trench desired. The whole arrangement is exceedingly simple, cheap and efficient. The centrifugal steam pump churns up the sewage so that when it comes to the field it resembles dishwater in appearance and is so dilute that it has very little odor.

The population of London asylum is in round numbers 1,000 patients and 200 sane people. The quantity of sewage made in a day averages about 75,000 gallons. It requires two and a half hours each day to throw this on to the field, and within from half an hour to six hours (according to the season of the year and the moisture or dryness of the earth), after it is thrown into the trenches, it has been absorbed by the soil. It is never seen again by us, doubtless it reappears at the surface somewhere as pure spring water. Only two to four trenches are used each day, so that the soil as used is always ready to absorb the sewage. There is no pollution of the soil; it is as sweet to-day as before it was used at all for the purpose in question. The disposal of the sewage then is absolute, as complete, indeed, as if it had passed out of existence. But it will be asked, how is it when the ground is soaked with long continued rain, or when it is frozen hard in very cold weather ? Neither of these conditions trouble us. The sewage always disappears in the soil, the process only somewhat checked by previous soaking, and only slightly checked by frost; for the sewage, even in winter is always many degrees above the freezing point, and it thaws the soil sufficiently to make way for itself. Granted then a sufficiently porous soil, which can be found within moderate distance anywhere, this mode of sewage disposal is simple, certain and cheap. No expensive plant is needed, and there are no chemicals or other supplies to purchase to carry it out.

But this is not all, these are not its only recommendations. For the first few years, after adopting this method at London asylum we used the field for sewage disposal only; we simply kept it clean of weeds and grass, and maintained the level and form of the trenches. But seven or eight years ago the temptation to experiment with the field as a garden took possession of us. All that we did in this direction prospered. We watered the plants grown on the field with the sewage, being careful not to use it at such times as it could taint such a crop as (for instance) strawberries. We found from the first that in the beds between the trenches (although the soil in them was poor), we could grow by aid of the sewage immense crops. For six years now we have cultivated this field to its full capacity with the result that we grow upon it year by year crops of fruit and vegetables to the value of over $200 per acre. So that over and above the disposal of our sewage in a cheap and cleanly manner the sewage itself is so used as to bring us in several hundred dollars a year more than the field in its original condition could possibly (without the sewage), be made to produce. The crops we have grown upon the sewage field in the last six years have been as follows: Water and musk melons, squash, pumpkins, celery, peppers, cucumbers, tomatoes, peas, radishes, chilies, lettuce, beans, cabbage, beets, carrots, corn, onions, turnips, salsify, sea-kale, asparagus, parsnips, strawberries. Every one of the crops grown on the sewage field has done well. One of our most successful crops is melons, both musk and water, which we grow there every year. The yield is immense and we have grown better melons on this field than I have ever eaten grown elsewhere. We have had immense crops also of cabbage and celery, and the quality of the crops has been much above the average. I need hardly say that the fruits and vegetables grown on the field are as wholesome as those grown elsewhere. Neither is the health of those who work upon the field in the least affected, there are no healthier people about the institution than they. Why not ? The field is simply a beautiful garden which is kept well manured and irrigated.

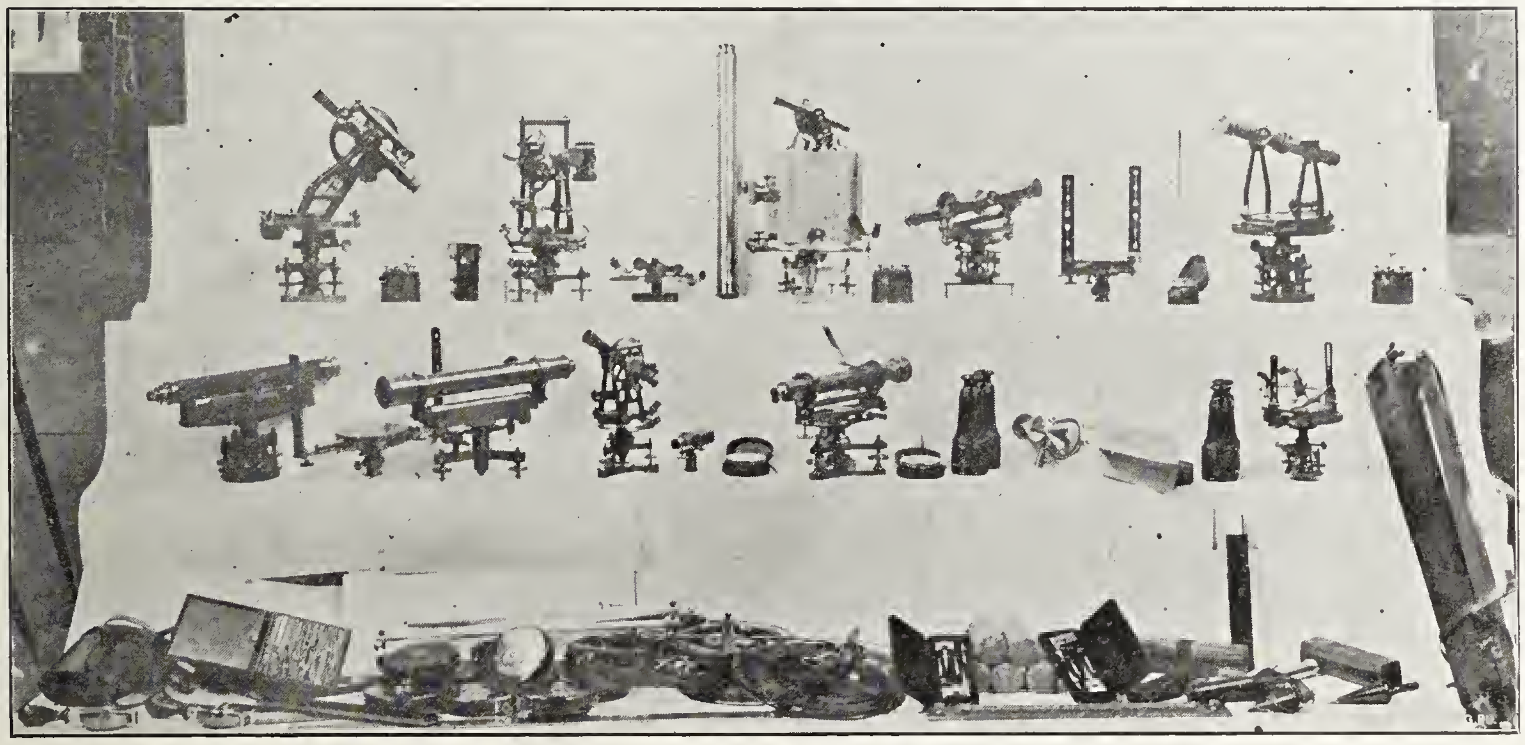
To sum up. The advantages of this mode of sewage disposal are many and great. It is cheap, simple, cleanly, not liable to get out of order, wholesome. It would seem to be nature's own plan of refuse riddance. It seems clear that solid excrement, including dead bodies, should be returned to the earth whose chemistry is competent to deal with it and utilize it without itself receiving taint or injury, and not to the waters which have no use for it, and which are tainted and grievously injured by it.

THE SURVEYING EQUIPMENT OF McGILL COLLEGE.

In consequence of the rapid growth of the Mining Department of McGill College consequent upon the completion of the McDonald mining laboratories, it became necessary to largely increase the equipment of the Surveying Department. This was made possible by the generosity of the same benefactor, W. C. McDonald, of Montreal. The accompanying engraving shows a number of the instruments added under this donation. It was made from a photograph taken in the east room of the Architectural Department.

The full list of instruments purchased is as follows: From Troughton & Simms, London, Eng., 14-inch Charlton Model, Dumpy Level; from L. Casella, London, Eng., 3-in. Transit Theodolite, Brydges-Lee, Photo Theodolite, Box Sextant with Supplementary Arc; from W. F. Stanley, London Eng., Box Sextant, Box of Drawing Instruments; from L. Lesdorpf, Stuttgart, Germany, Wagner Pocket Level, Precision Level, 4-in. Transit Theodolite, Goldschmid Aneroid Barometer, Prismatic Reflecting Circle, two sets Beam Compasses; from Martin Veig, Christiania, Norway, Wrede Pocket Level; from Chesterman & Co., Sheffield, 30-in. Straight Edge, 3 100-ft. and 1 66-ft. steel bands, half dozen linen tapes; from G. Cooper, London, Eng., Sidereal Watch; from Young & Sons, Philadelphia, U.S.A., 6¼-inch Railroad Transit, 6¼-in. Mining Transit with three tripods and interchangeable lamp targets; from Buff & Berger, Boston, U.S.A., 14-in. Dumpy Level; from Keieffel & Esser, New York, U.S.A., combined Architect's Level and Transit, 100 ft. steel band, 300-ft steel band for mining work, slide rules, scales, plum bobs and other minor equipment; from Lufkin Rule Co., Saginaw, U.S.A., 2 Steel Bands, ½ dozen Linen Tapes; from W. & L. E. Gurley, Troy, U.S.A., 4 Plane Tables, 2 Surveyor's Compasses, Solar Compass, Pantograph, Price Current Meter; from Hearn & Harrison, Montreal, Rochon Micrometer, 2 Aneroid Barometers, 3 Hand Levels, 2 Lemaire Field Glasses, Box Sextant, Parallel Ruler, Scales and minor drawing implements.

The effect of this donation has been to increase the number of instruments available for field work by fifty per cent. and to place ample opportunities for practical work at the disposal of every student. In order to give the students full time to profit by this addition the session has been lengthened by one month in all the departments taking the surveying course, and the entire month of September has been set aside for field work. Some time in addition to this is given to underground surveying during the spring mining excursion. The course in full is designed to give the student all the technical knowledge necessary in order to qualify as a Dominion Topographical Surveyor in addition to the regular methods of practice in railroad hydrographic and topographical surveying. The instruction is given by field work, lectures and plotting, and office work; the work in these latter being based upon the notes taken by the students in the field work. The field work will be given this year in and around the village of St. Andrews, Que., and will commence with preliminary practice in the use and adjustment of the instruments to be followed by the carrying out of the following surveys by the several years:



INSTRUMENTS IN THE SURVEYING DEPARTMENT OF M'GILL UNIVERSITY.

Fourth Year Work.—Base line measurement, triangulation by geodetic methods, precise levelling, magnetic observations, and the determination of latitude, longitude, azimuth and time both in the day time and at night.

Third Year Work.—Topographical surveys of selected areas by plane table stadia and photo theodolite, a hydrographic survey of part of the Ottawa river, including the determination of its discharge, a location survey for a railroad between Carillon and St. Andrews.

Second Year Work.—Chain Survey of part of the village, compass and chain survey of farm lands, micrometer surveys.

In the making of these surveys the years are divided into small parties not larger in number than would be employed in practice, and each party carries out its complete set of surveys independently, each student being required to have a full set of notes of the work done by his party. The students are thus compelled to learn to carry out the duties which will be given them in practical work, and the necessity of full and accurate notes is impressed upon them in the plotting of their own surveys, which is done in the winter months after field work has become impossible. From the plans thus made quantities and estimates are calculated.

The field work and mapping has been organized in this manner so that the students may fully appreciate the practical importance of the facts concerning theoretical and practical surveying that they hear in the course of lectures upon this subject, and will learn to depend upon their own judgment and to understand that an acquaintance with the literature of a subject does not qualify a man completely for the practice of it. The organization and conduct of the surveying department is under the charge of Prof. C. H. McLeod and his assistant, J. G. G. Kerry.

W. W. Ogilvie is building what will be the largest grain elevator in Montreal. The plans are already completed for its construction, and it will have a capacity of 2,000,000 bushels. It will have a frontage of 240 feet and a depth of 290 feet.

RECENT METHODS OF SEWAGE DISPOSAL.

BY CHARLES G. HORETZKY, C. E., OF THE ONTARIO PUBLIC WORKS DEPARTMENT, TORONTO.

The following paper on the most recent methods of sewage disposal now in operation in the United States, being to some extent the outcome of experiments made by the Massachusetts State Board of Health, with remarks upon their adaptability (in whole or in part) to cities in Canada, was read before the Association of Executive Health Officers of Ontario during the meeting in Ottawa in September, and also at the meeting of the American Public Health Association.

At the tenth annual meeting of the Association of Executive Health Officers of Ontario held at Belleville, Ont., in 1896, I read a paper upon Methods of Sewage Disposal then used in some of the Provincial Institutions of Ontario. In December, 1895, I was one of the consulting engineers with reference to the disposal of the sewage of the city of London, Ont., and then recommended a system of land disposal or filtration; my recommendation being largely based upon the successful working of the Brockton, Mass., plant then in operation, and upon the very doubtful success of several chemical systems visited upon a tour of inspection through the United States in October of that year. Since 1893, further, and most important discoveries in this direction have been made by the Massachusetts State Board of Health at their Experimental Station at Lawrence, Mass., where the last few years have been devoted to researches upon the capabilities of gravel and coke filters aided by forced aeration. A description of these experiments would be interesting, but out of place here, and can be seen in the different annual reports. It will suffice to say that the conclusions arrived at offer a great incentive to the practical ingenuity of all those interested in the construction and maintenance of sewage disposal plants.

It has been demonstrated that filters of gravel of an effective size * of 5.40 MM. can produce a most satisfactory effluent, and remove from 60 to 85 per cent. of the organic matter of strong city sewage, at the rate of 400,000 gallons daily per acre. Coke breeze (screenings from commercial coke) has also been found of immense value as a filtering and straining medium, and possesses the advantage of being fully as valuable for purposes of combustion after its use as a sewage strainer and sludge retainer, as before. This will be discussed further on. As regards the forced aeration applied to these experimental filters, pipes were passed through, and within 6 inches of the bottom. A fan blower driven by electricity was attached, and, while the fan made 3,600 revolutions per minute, an air current capable of sustaining 3 inches of mercury was forced through the filters. By frictional loss the force of the current was reduced fully one-third.

In the experiments with the coke filters up to January 1st, 1895, the average rate of filtration was 260,000 gallons per acre

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*(Note: In a sample of sand or gravel, the effective size is the maximum diameter in millimeters of the finer ten per cent of the sand grains, or gravel).

daily for six days in the week, while the average removal of organic matter (albuminoid ammonia), and bacteria was 95 and 98 per cent., respectively. In 1894 Col. Waring instituted experiments upon sewage purification aided by forced aeration, at Newport, R. I. These were continued during five months from May till October, and the results set forth in a pamphlet which also contains a synopsis of the chemical work and investigation carried out simultaneously by Geo. W. Ralfe, A. M. (Harvard). The Willow Grove Park (15 miles from Philadelphia) sewage disposal plant was constructed shortly after upon the principles evolved by the Newport experiments. It is simply composed of a set of strainer and aerator beds, one-eighth acre in extent in all. The sewage applied daily is assumed to be from 60,000 to 100,000 gallons. The resulting effluent at date of my visit on 6th Sept. was very good, clean and odorless, and the most of it was in daily use for sprinkling the lawns and roadways at Willow Grove. I found, however, that the receiving well was clogged with hard compact sewage to the depth of 4 feet. This will have to be removed eventually by hand, as it cannot be pumped up. The man in charge informed me that the plant had been one year in operation, and that the strainer beds have to be overhauled every season (six months), and the material washed and returned to its place. This, he says, occupies three men during a week.

As to the conclusions arrived at by the chemist in charge during Col. Waring's Newport experiments, they indicate that a strainer tank can remove 40 per cent. of the nitrogenous matter in ordinary sewage, if this sewage, roughly strained and free from mud, is applied continuously, at a minimum rate of 3,000,000 gallons daily per acre; and that an aerator bed one acre in extent, with nitrification properly established, and proper manipulation, will remove 95 per cent. of the organic nitrogen of a strainer effluent, applied at a rate of at least 800,000 gallons daily. It will do so for an indefinite period, under, of course, proper conditions of working. This means that ¼ acre of strainers, and 1 acre of aerators (1¼ acre in all), will suffice for the treatment of the sewage of 10,000 people at the rate of 80 gallons per capita. I have been unable to obtain the cost of the Willow Grove plant, now about one year in operation, which includes the pump house, pump, blower, masonry and concrete work, filtering material, and all accessories; hence, it is difficult, nay impossible, to compare it in the large and practical way with other methods which will be discussed further on; but, from my own actual observation, and the statements of the man in charge, I am of the opinion that the conclusions reached by the experimenters are quite in accordance with the actual working of this very valuable system of artificially aerated bacterial filters as claimed by the inventor, whose theory regarding "Bacterial oxidation" of sewage is pretty generally understood.

Reverting to the Massachusetts State Board of Health experiments with coke, I now quote an extract from page 480, report 1896, which sums up the immense value of this material as an aid to sewage purification, and especially as a sludge retainer: "When Coke Breeze can be obtained, and the sewage given a preliminary treatment before sand filtration, by being passed through this breeze at a high rate in gallons daily per acre, the organic matters can be removed from the entire body of the sewage as completely as chemical precipitation removes them from the main body of the sewage. There is no resulting sludge liquor from this coke straining process, and the clogged coke can be removed from time to time and burned, the sludge being of course held by, and burned with it.

"During some of the experiments 13.8 cubic yards of coke per million gallons of sewage filtered were removed, dried and could have been used as ordinary fuel. By straining through coke we have removed during 1895, 54 per cent of the sludge (albuminoid ammonia) of the sewage. The latter has been strained at an average rate of one million gallons per acre daily, and the coke strainer contained from 6 to 8 inches in depth of coke. The coke is known as breeze (screenings from ordinary coke). At the Lawrence Gas Works where it is obtained, it is used under the boilers, and estimated to be worth one-fourth as much as the steam coal, or, from $1 to $1.25 per ton; the amount used has been 10 cubic yards per million gallons of sewage strained, and, as a ton of coke occupies about 2.3 cubic yards, the sewage has been purified, to the extent given, at a cost for coke of $5.43 per million gallons of sewage strained, estimating the coke to be worth $1.25 per ton. By this method we remove the sludge from the entire body of liquid, and get rid of the concentrated sludge liquor which results from sedimentation, or any chemical precipitation process, and, it seems that the coke is as valuable for combustion after use in the strainer as before."

I may add that in the coke filter experiments of 1895, the removal of organic matter and bacteria, at a rate of 260,000 gallons per acre daily, for 6 days in the week, was 95 and 98 per cent., respectively. Now, sludge resulting from sedimentation or chemical precipitation contains 90 per cent. of water, the latter being separated from the solids by a most expensive and dirty method of pressing. Even then, the resulting cake contains 50 per cent of water, and, using the lime and alum precipitation process (probably the best), the pressed sludge will amount to eight tons per million gallons treated, equal to 40 tons as swept from the tanks. As one-half of the pressed cake consists of water, the dry solids are equal to 4 tons per million gallons of sewage. In the Lawrence experiments above quoted, the sludge was removed by burning at a cost of $5.43 for coke per million gallons treated, while, in any chemical process, 8 tons of semi-fluid, evil-smelling cake are produced at a heavy expense for filter presses, cloth and labor, and afterwards the problem of getting rid of this foul asset has to be faced, since it is utterly futile to think of selling this cake to farmers, and the further expense of carting it away must undoubtedly be taken into consideration. In England the cost of producing sludge cake may be taken, at the majority of works (according to Santo Crisp), at 2s. 6d. sterling per ton; and the same authority states that although it is sometimes sold for a trifle, or taken away by farmers, the latter are as often paid to remove it. In the vicinity of large cities it has been dug into the ground, or spread out to dry, but, however, handled or disposed of, it is an undoubted nuisance; hence any method of sewage disposal whereby the sludge difficulty can be eliminated entirely, must recommend itself to practical men. In estimating the cost of sludge removed (per million gallons of sewage treated), by coke strainers, as against sludge pressing into cake, we have roughly, taking the Lawrence prices of materials used:

BY COKE STRAINERS.	
Say 4½ tons of coke at $1.25	$5.62
BY SLUDGE PRESSING.	
Pressing 8 tons sludge cake at 60c	$4.80
Carting away 8 tons, ditto	....
1,000 lbs. crude alum at $25 per ton	12.50
1,000 lbs. slaked lime at $9 per ton	4.50
Required for precipitation of one million gallons of sewage	$21.80

Therefore, is there much to be said in favor of coke as a strainer, as compared with any precipitation process; while the cost of buildings, tanks, and the other accessories required in the last named process, will certainly counterbalance that of a furnace, drying ovens and chimney necessary for clogged coke combustion. The Pennsylvania Sanitation Company of Philadelphia have taken advantage of the foregoing facts as regards the valuable properties of coke breeze and aerated sand and gravel filters, in their sewage disposal plant erected at Reading, Penn., which has been in very successful operation for the last year and a half.

The population of Reading is about 80,000, as I am informed, but so far only about 25,000 people contribute to the sewerage system. The average daily flow of sewage treated by the Philadelphia Sanitation Co.'s works during August last was 1,586,463 gallons. These works comprise a very handsome pumping station situated at 6th and Canal streets. This station includes two large receiving reservoirs in which the coke strainers are placed, two large pumps of 5,000,000 gallons capacity each, three 65 h.p. boilers, drying ovens and tall chimney stack, which ventilates the receiving chambers. A force main 7,200 feet in length conducts the strained sewage along the banks of the Schuylkill River to the filter beds. These filter beds comprise an area of 25,000 square feet, or fifty-seven hundredths of an acre. One-half of this area is supported by an iron structure, and is at a level 8 feet 6 inches higher than the lower half. The upper beds are divided up into ten compartments, each 25 feet by 50 feet. Iron pipes resting upon beams and girders, supported by iron columns, carry the filtering materials which consist of three different layers of broken stone and rather fine sand; the whole being two feet in depth. The surface of the filters is protected from wind and the erosive action of the falling sewage by a slatted floor removable for cleaning purposes.

There is usually one foot head of water on the upper filters while in operation. The open grid-iron like bottom affords access to the outside air, and is, in fact a modification of the forced aeration experiments of the Massachusetts State Board; further aeration is obtained by the 8 foot 6 inch rain-like drop of the effluent to the surface of the second filter, which is of coarser material, and about three feet in depth, and is aerated throughout by pipes and gutters. The effluent from the last filter emerges as a clean, bright fluid, quite sufficiently purified to enter any large stream or river, and certainly of a better quality than that of the Schuylkill into which it finally empties.* Bacterial and chemical analyses of the effluent from this plant have been made in Philadelphia, and these show high results, as the accompanying statement indicates. Usually about one-half only of the filtering area is in operation, the other half being rested, aerated and cleaned. The cleaning operation involves the daily removal of about two tons of the sand on the top of the filters which has become clogged by the organic matter still remaining in the coke strained effluent. This daily loss of sand costs about $2 for the material alone. Reverting to the preliminary operation undergone by the crude sewage in the receiving chambers at the terminus of the main sewer, there are two suspended layers of coke, 12 inches thick, through which the sewage must pass. The upper one holds back the coarse sludge, while the lower effects a partial filtration or straining of the sewage before it is taken hold of by the pumps. Every week the sewage is shunted from one receiving chamber to the other, and the clogged coke of the upper strainer is entirely removed, hoisted to the drying ovens, and finally consumed under the boilers as ordinary fuel. The weekly removal of clogged coke from the upper strainer is about 5 tons. In my opinion the clogged coke should be removed at more frequent intervals, and the coke should be, not commercial coke such as I saw, but breeze, or ordinary coke broken up into very small fragments. I believe the specifications of the Sanitation Company demanded "breeze," but, since the plant has been turned over to the corporation of Reading, several changes for the worse seem to have been made. During last August the cost for steam coal was $72 for 48 tons. In addition to this 16 tons of coke from the receiving chambers were burned. The total quantity of sewage pumped during that month was 49,180,368 gallons. The cost of this plant has been given to me as under:

Pumping station complete with 1 pump and 2 boilers	$59,000
The pipe line	31,000
Site for disposal works	7,000
Right of Way	1,700
Iron structure for filters complete, including viaduct over creek and all accessories	62,300
	$161.000

As one-half of the upper filtering area is said to be generally out of operation for cleaning purposes, it follows that the daily flow of sewage treated (1,586,463 gallons), passes through the upper filter at the rate of about 2,286 gallons per square yard, or 11 million gallons per acre. Although this seems an enormously rapid rate, it must be borne in mind that the second filter below will pass the effluent from the first filter at only half the above rate, and that, with the large amount of aeration obtained, not only by falling through the 8 foot 6 inch air space, but through the last filter, very good results can certainly be looked for. As a matter of fact a very fair sample of effluent was collected by me on the 4th instant. As regards cost of labor, it is safe to say that four men and a foreman could very well attend to the filters, although at present three foremen and eight men are employed by the corporation of Reading. Careful examination and enquiry as to the operation of the Reading sewage works have convinced me that this practical application of coke straining and aerated filtration is worthy of the very serious consideration of the London, Ontario, authorities, who still have the vexed (and to them doubtless most perplexing) question of their sewage disposal before them.

On account of several conditions essential to successful intermittent filtration through land, which are not always obtainable, this plan is certainly far in advance of land disposal pure and simple, over large areas, as it is generally understood in Ontario, and which I unequivocally recommended three years ago. But this is in reality a land disposal system in a much condensed form, with but a fractional portion of the duty imposed upon it as in ordinary cases, by reason of the prior removal of the bulk of the sludge by coke combustion as already described. Upon this account, and that of the reduced cost of construction and future maintenance, as compared with other proposed plans, I unhesitatingly recommend it now. The Pennsylvania Sanitation Co., of Philadelphia, have offered to construct a disposal plant at the outlet of the Cove Road Main Sewer, much upon the same lines as that of Reading (the London works of course to be a gravitation system), for the sum of $28,000. This is upon a basis of one million and a half gallons of sewage to be treated daily. I have carefully gone into the plan proposed by them for London, and feel confident that, with certain modifications, which include receiving chambers, coke ovens, furnace and chimney, besides provision for burning the rakings from the upper filter, an excellent system can be constructed for the sum of say $33,000. The company would, I have no doubt, be glad to operate the works for one year, and guarantee a given, satisfactory standard of purity in the effluent.

The whole work necessary in caring for the filter beds, handling, and finally burning the clogged coke, could be performed by four men and a foreman. The weekly cost for coke (the only material requiring renewal, besides less than a couple of tons of sand daily), would be about 5 or 8 tons, the total weekly expenditure for materials for one week being, 8 tons of coke, and say 12 tons of sand. The cost of chemicals alone, per week of 7 days, would be for the International System, using 7 grains of ferozone per gallon of sewage (7 grains ferozone per gallon of sewage are not sufficient, as I have found by actual experience, 10 grains are necessary), and estimating the cost of ferozone at ½ cent per pound (which is 50 per cent. less than I ever obtained it for): 10,500 lbs. at ½ cent=$52.50 per week, or $2,730 per annum. So much for maintenance; now for the cost of construction by either of the three plans proposed for the City of London:

LAND DISPOSAL.

40 acres of land at $175	$7,000
Preparing ditto	24,000
Syphon and other items	10,000
	$41,000

INTERNATIONAL PROCESS.

Cost of construction as given	$41,300
Plan now proposed	$33,000

The latter, besides being less costly, possesses the inestimable advantage of being entirely freed from the sludge nuisance. The interests of the city of London can be protected by the company's guarantee to keep up a certain standard of purity in the effluent during the period the works are operated by them. The location of these works at the end of the Cove street sewer would of course obviate the necessity for a syphon as now proposed.

The city of Worcester, Mass., may safely be taken as a typical illustration of chemical precipitation for large cities, and the report for 1896 may be referred to, in which it is shown that, for maintenance, and purification of one million gallons of sewage, the cost has been $10.52, 53.9 per cent. of the organic matter having been removed; and yet Worcester is now engaged upon the construction, at great expense, of a filtration plant as an auxiliary to their present method. The sludge from the Worcester works has always been found very difficult to get rid of, and when there in 1895 I saw very large areas covered with it to a depth of 12 or 18 inches, small quantities of which the neighboring farmers could scarcely be prevailed upon to take away as a gift. Enough has now been said on this head, and the method of precipitation as applied to large towns with its sludge concomitant, may be dismissed with a quotation from Col Waring: "The precipitation treatment buys and manipulates chemicals, coagulates the sludge, drains it, pumps it, handles it, and still has it."

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*These works have been extremely well designed, and appear to me to be an excellent practical illustration of the Massachusetts experiments with coke and "forced aeration." The filtration area is rather circumscribed—a defect easily remedied Too much credit cannot be accorded the designer and engineer—John Jerome Derey, of Philadelphia.

It must not, however, be gathered from the foregoing remarks, that the writer has receded from his many previously stated convictions regarding precipitation methods. There are and always will be cases arising, where, in the absence of coke or suitable land, chemical precipitation will be found a powerful aid to the final filtration of sewage, either through natural or artificial media; and this applies particularly to the sewage disposal of small communities, e.g., as in some of our provincial institutions, or other small centres of population.

Since reading the above paper in Ottawa I have suggested a still further modification in the method proposed for London, which is to use 20 acres of land for the final filtration of the sewage, after straining through, and retention of the sludge by coke. This is a combination of the Reading plan with simple land filtration, and would effect a saving to London in cost of construction of nearly $20,000, as compared with the original "all land disposal" plan and the chemical "International system."

DR. KINGSFORD.

Dr. William Kingsford, C. E., the Canadian historian, died at Ottawa, Sept. 29th, in his 79th year.

He was born in the parish of St. Lawrence, London, England, in December, 1819, was educated there and spent some years in the army, coming to Canada with the 1st Dragoon Guards. On leaving that regiment, in 1841, he obtained professional employment in the city surveyor's office, Montreal, and was subsequently for three years deputy city surveyor. He resigned his position to join the late Murdo McIver, on the Montreal Times, being with that gentleman part proprietor and joint editor of the paper. After two years the paper was discontinued and Mr. Kingsford returned to his profession. He was appointed to the engineering staff of the Public Works Department, remaining there for two years, during which time he completed an important survey in connection with the Lachine canal, determining the boundaries of the Crown property. Proceeding to the United States, in 1849, he was engaged there on the construction of the Hudson River Railway. Later he went to Panama, where he became assistant to John C. Campbell in laying down the line of the Panama Railway from San Pablo, on the Chagres, to within a mile of Panama.

On his return to Canada he was appointed by the Commissioner of Public Works on the location surveys of the Grand Trunk Railway. He surveyed the line from Montreal to Cornwall, and also examined a back line from Brockville to Rideau. Subsequently, he surveyed and located for construction a line on the south shore of the Ottawa from Vaudreuil to Montreal, now the C. P. R. short line. Resigning his position on the Grand Trunk, he accepted the city engineership of Toronto, which, however, he held only for a few months, going back to serve under the late A. M. Ross, engineer-in-chief of the Grand Trunk Railway. In 1860 he returned to England. Subsequently he was employed in Italy in the examination of several works. He also reported to Mr. Brassey, on the condition of the Sardinian railways. Six years later he returned to Canada and again entered the public service. For several years he was engineer in charge of harbors in the provinces of Ontario and Quebec. Afterwards he was employed on the Canadian Pacific Railway. When his engagement on this road terminated, Mr. Kingsford, whose tastes had always been literary, and who had contributed much to periodical literature, resolved to undertake the preparation of a history of Canada from its settlement to the union of Upper and Lower Canada. The first volume of this work appeared in 1887, since when a new volume has appeared every year. His other contributions to literature in book form include: "History, structure and statistics of plank roads in the United States and Canada," 1852; "Impressions of the West and South," 1858; "The Canadian canals, their history and cost, etc.," 1865; "A Canadian political coin; a monograph," 1874; "Canadian Archaeology; an essay," 1886; "The early biography of Ontario," 1892; "Some considerations on the advantages we may hope to derive from education," 1898. The degree of LL.D., was conferred upon him by Queen's and Dalhousie Universities in honor of his history of Canada. He was a Fellow of the Royal Society of Canada.

PURIFICATION OF SEWAGE BY MIXING WITH PURE WATER.

BY W. M. WATSON.

I have been asked the question, "Is it injurious to discharge sewage into large sheets of fresh water similar to the Georgian Bay, or rivers similar to the St. Lawrence at Montreal?" My answer is, "Yes." And those like myself who have seen the effects of discharging raw sewage into the rivers and lakes, and even into tidal waters of the ocean, surrounding Great Britain, will have no difficulty in bearing similar testimony. It is possible to purify sewage through the agency of pure water, but to do this the sewage must be mixed with at least three times its own volume of fresh water, and both be well shaken together so that every molecule of the sewage liquid comes into close contact with at least three of the pure water. When this is done the cleansing microbes contained in the pure water are able to destroy the dangerous microbes that the foul sewage contains, and herein lies the difficulty, because the mechanical appliances needed to supply the quantity of pure water, and properly mix it with the sewage, will usually cost more than cleaning the sewage by artificial filtration. When sewage is discharged in bulk into rivers and sheets of clean water it moves through and passes along with the currents in a compact body, and being slightly heavier, on account of the solids it contains, it settles to the bottom as soon as the temperature has been reduced to the temperature of the water surrounding it. It then sets up a rapid putrefaction, breeding and multiplying dangerous germs, which in course of time become so numerous that however large the sheet of water may be, they become masters of the situation, and either foul the whole body of water and cause it to discharge a foul odor as do Toronto and Hamilton bays, or the poisonous gases generated belche up in volumes through the clean water, and cause a nuisance similar to the gases discharged from the sawmill refuses lying at the bottom of the river at Ottawa. In many cases large patches of the microbe-bearing filth will float to the surface, and be cast on to the banks, jeopardizing the health of the inhabitants. This can be seen in many places where raw sewage is discharged into tidal rivers, bays and large lakes of fresh water.

It may be possible that a rapid running river will purify its contents, but it is very improbable that it will purify raw sewage. I have often read of attempts to prove that the sewage of a town got purified after running for about six or seven miles down stream, and the analysis of water taken from the surface has appeared to prove this to be the case. But experience, and the hundreds of fouled rivers in Europe prove decidedly that the scientists are wrong. As I have stated, the sewage falls to the bottom and so leaves the surface of the river clean and pure, and it is on this account that taking samples of water and analysing them is misleading, for the evil is still in the river, but resting on the bed at the bottom. It is from the sludge at the bottom, in quiet places, and under rocks where the currents are not felt that the sample for analysis should be taken.

The argument that a town or private residence can run its sewage into clean water without injuring their neighbors and future generations is stale and untrue, and it should not be entertained for one moment, for there are thousands of examples in the older countries that will refute it. Only this morning I read a letter published in The London Times, written by the Archdeacon of Gloucester, England, complaining bitterly of the fouling of the fresh water streams of England, and killing the fish they formerly contained. He showed the folly of pretending to purify sewage by irrigative land. Here is an extract from the reverend Archdeacon's letter; let him speak himself:

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"Let me ask your help in promoting such welfare in one momentous direction—the disposal of sewage. There are few evils, in my opinion, more pressing or even scandalous than the pollution of rivers. Water is one of God's most precious gifts (poor East London will testify to this). To turn a fair river into a foul drain, seems to me, not only a hideous blunder, but a hideous crime. Will you let me open a correspondence on the cremation of sewage, for our pest may thus be turned even to our advantage? I plead for the erection of huge furnaces at the outfalls of our drains. No doubt they would require lofty chimneys, and chemical ingredients to neutralize the noisome gases; but this, surely, cannot be beyond the reach of science. In these furnaces the solid matter would be burnt, and form artificial manure; the liquids, being properly filtered and deodorized, might then be allowed to flow away. Let us sum up our present position. Our beautiful West Riding rivers are only awaiting their time for being turned into foul channels of manufacturing centres. 'Sabrina fair,' is rapidly becoming 'Sabrina foul' to the great discomfiture of the salmon. Limpid Thames is condemned to bear the ignoble burden of London sewage. Have we not heard of a huge sewage island being piled up on the borders of Essex? Have not the oyster sellers been half ruined by sewers disgorging themselves near the oyster-beds of Kent? Have we not heard of the 'Ealing Styx'—the Brent? Fifty-seven years ago my father had his kitchen garden surrounded by that pretty river at Hanwell. I am now staying on the coast of South Hampshire. A nice little trout stream empties itself past the village into the sea. Up the stream trout are caught abundantly, below the houses large fish are caught, but ought not to be eaten, for a disgusting freight of sewage is carried to the sea, and Oceanus has to dispose of the accumulated poisons as best he may. Shame to say, it is the same story for all our watering-places.

"Now, what are the palliations on which we place our reliance? Miserable subterfuges indeed—sewage farms. At first we heard much of the enrichment, now we hear of the poisoning, of the soil. At best it is the spread of noisome exhalations over fair fields instead of fair rivers. I do not envy the olfactory senses of the man who walks anywhere near the sewage farm. The huge sewage marsh at Saltley, near Birmingham, had to be thickly covered by masses of sand and gravel, I suppose to be in their turn as much poisoned as the stratum which lies below them. No doubt we must come to cremation sooner or later; but why not sooner than later? I throw out this suggestion, to be taken up, I trust, by practical and scientific men. I am sure he will be a public benefactor who can turn a curse into a blessing."

This is the view of a gentleman ripe in years, who has watched the irrigation of land, and the mixing of sewage with large quantities of clear water for half a century, and he tells us that they are useless and a mistake, and breeders of filth and foul odors. The slow going government of Great Britain has at last come to see that the two systems are of no value, and have lately begun an exhaustive enquiry into every known system of sewage disposal, and intend examining all expert engineers and managers of sewage purification works on oath, and if possible find out the proper system of cleaning and extracting all poisons from sewage fluids. They commenced in August, but adjourned to October, when the holiday season would have expired. They will then continue with closed doors, as the commission is determined not to allow the papers to report the proceedings until it publishes its own report and opinions, which cannot be until probably next spring, as the enquiry will be lengthy. It is hoped that the enquiry will bring to light a system that will be both efficient and permanent, at a reasonable cost, and so supersede the many worthless processes now in use.

ROPES AND ROPE DRIVING.*

BY L. H. KENYON, DUKINFIELD.

To trace the history of rope driving, we should have to go far back beyond the days when Hero of Alexandria applied his discovery of steam power to rotary motion, which but for fanaticism, that great impeder of all progress, would centuries ago have deprived Watts of the glory of first invention. We must search amongst the mounds of Nipur (which have recently proved that civilization is older by 7,000 years than the world was supposed to be), and among the ruins of ancient Egypt to find the clumsy first forms of the potters' art. Comparing these with later but still early productions, when grace, beauty and utility first joined hands, we come to the time of the potters' wheel. Still later the Hindoo wood turner begins to ply his trade, and may even to-day be seen sitting, as his ancestors have done for unknown ages, with tool in hand ready to catch the backward turn of his lathe, as his half naked attendant "see saws" at the ends of a rope whipped several times round the hub. Or again come down to still later times in our own country, when we have the spinning wheels. Arkwright after repeated experiment found it advisable to still adhere to this principle for driving the spindles of his spinning machine, a method which modern development has only sought to improve. Strange to say, some thirty years ago when the machinery of the mill occupied by this genius was undergoing re-construction, a system of rope transmission was found to be in full operation. How long this had existed we can only conjecture, but doubtless some obscure mechanic had conceived the idea of applying band driving to higher powers from the models around him, or it might have been the offspring of the master mind. At any rate the fact remains, notwithstanding the many who claim to be the foster parents of the system.

For all practical purposes rope transmission may be regarded as positive, all things being equal, and in making calculations for speeds the supposition that slipping and consequent diminution of speed must of necessity enter into the equation, may be dismissed as scarcely worth consideration. Cases have come under the writer's observation where ropes have supplanted spur gearing, and the machinery indicated loss of speed, but after the most careful investigation the main driving proved dead true to the decimal, and, in one instance, the pulleys were altered throughout the room affected, to meet the difficulty arising out of a misunderstanding of the initial speed. Beyond this, and of supreme importance to power transmission, is the elasticity of rope driving, for the ropes themselves are very sensitive to any irregularity and act as a buffer between the initial and ultimate power, making back-lashing, the bane of gear driving, an unknown quantity. This quality is displayed to a remarkable extent in driving from gas engines, where the ropes may be seen readily yielding to every impulse, and just as readily recovering their normal tension without transmitting the shock to the machinery. If even a slight loss of power be admitted, the general effectiveness of ropes more than compensates for this, which is too often magnified beyond its merits, and can be reduced to such dimensions as will enable the engineer to ignore it entirely in actual practice. It often happens that reports are received of ropes slipping, which on investigation prove to be quite groundless. Should there be any slip it can easily be detected by the heating of the pulley. Unless, then, pulley rims are unbearable to the touch from frictional heat, it may be taken for granted that there is no perceptible slipping. Stress should be laid upon this, because frictional heat appears to be rarely associated with slipping, and the evil is often declared to exist without its natural result.

In our works we have tried a ⅝-in. diameter rope running over a loose pulley 18-in. diameter, with grooves of an angle of 90 degrees, making 160 revolutions per minute, or a rope speed of about 720 feet per minute. This 18-in. pulley was brought to a dead stand, and as the driver was only 12-in. diameter, caused the rope to run only about one-fourth its proper speed (say 180 feet), and in rather less than two minutes the paint on the inside of the rim blistered and smoked with the heat. In the above-mentioned experiment, the heat was generated upon a portion only of the surface on account of the pulley being stationary, but when in motion the heat is more evenly distributed, so that it would not require a great amount of slip on a large driving pulley to set up heat sufficient to scorch the ropes. What would be the result with a pulley 3 feet diameter, an acute groove, and a number of ropes of larger size, side by side, slipping at the rate of 60 feet per minute? And yet we have a case in hand at the present time, where an engineer has proved over and over again to his own satisfaction, that of four engines running side by side, the ropes are slipping on two of them at the rate of 60 feet per minute. This was said to be going on continuously, without producing the slightest heating of the pulleys or injuring the rope in the least degree. If then, there is loss of speed on the machinery and no heat on the rim, the cause must be looked for elsewhere than in the rope chamber.

To those who lay so much stress on wedging action, back tension, etc., the following problems might prove interesting:

Say, the wedging of a rope into its groove is stated as 50 lbs. (an excessive estimate) and the centrifugal force for 1¾-in. diameter travelling 4,700 feet, is 192 lbs. What amount of power can be absorbed on extracting the rope after accomplishing its purpose? Or how can these opposing forces co-exist?

The resilience of a well made cotton rope is such that perfect impact into the groove is impossible, even when the rope is forced into it under far greater pressure than is ever exerted in actual practice. This causes it to spring away immediately the tension is withdrawn, even from a groove with sides at an angle of 25 degrees, and with the pulley stationary. How much less then would this presumed wedging action apply to grooves of 40 degrees with the pulleys running at a high rate of speed?

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*A paper read before the Manchester Association of Engineers.

As in every other method, there are many points to be observed and enforced before the high tide mark of efficiency may be reached. First and foremost, the construction of the groove; and let it be said that simple as it may appear, the contest between one style and another has been keen in the extreme. The most effective style of groove is that with straight sides resting at an angle of about 40° and of sufficient depth to prevent the rope reaching the bottom, or the curve with which the groove terminates. On no account should grooves with curved sides be used, as it is impossible for ropes to bed themselves, and they roll round, do not last near as long, and are not as effective. It need scarcely be said that the grooves of both driver and driven pulleys should be turned to the same template. Although there are numerous instances where ropes have been expected to do well when they were running in grooves of totally different make and size.

It is generally acknowledged that ropes should not be run upon pulleys of less than 30 times their own diameter. Although good cotton ropes will coil in considerably less compass, yet it is always wise not to go below this limit, and err, if at all, in the direction of large size pulleys, as the repeated effort of compression and extension produces what is well expressed as "fatigue of material," when the elasticity is worked out. Ropes suffer more from this cause than any other. The writer has come across numbers of cases where the relative diameters have not been more than half this, and ropes have been expected to do just as well as under more favorable circumstances.

The best results may be anticipated when the smallest pulley is 50 times the diameter of the rope.

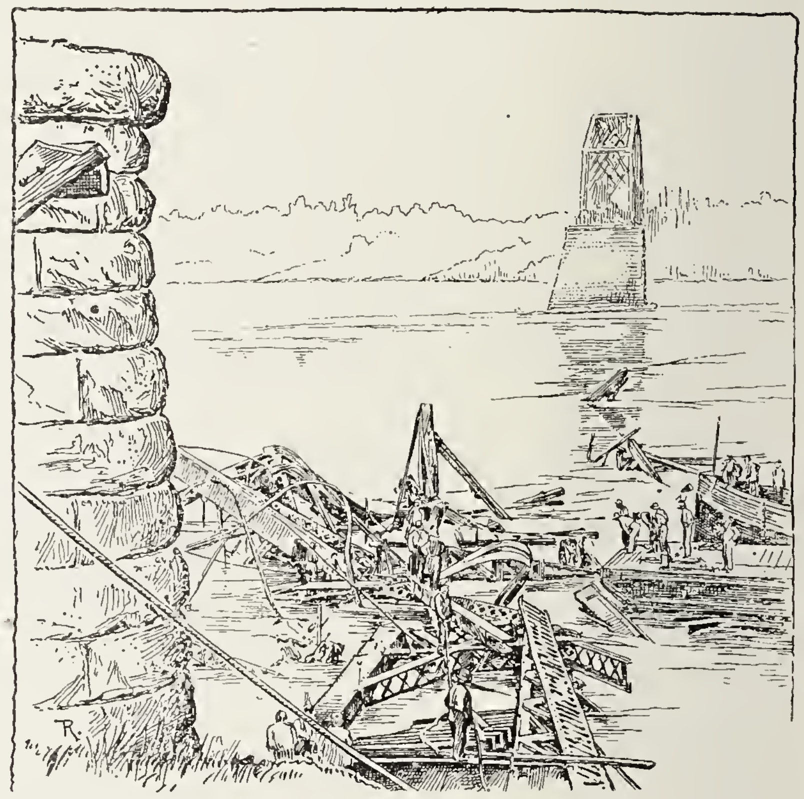
Whilst it may be safe to advocate forward driving generally, i. e. with slack over the pulleys, the writer fears he will be compelled to renounce his faith in its supremacy for all conditions, and advocate another method for horizontal and down driving particularly, since recently comparing notes upon the many methods under consideration. He can bring to mind quite a number of cases where back driving has been adopted perforce with the best results. So smoothly do these ropes run that the idle side maintains the same equal curve without any perceptible deviation, whilst under similar conditions forward down driving has been anything but steady, and there has even been a difficulty in keeping the ropes in the grooves. Therefore, to secure effective down driving, back motion becomes almost a necessity. The great reason for this is that the centrifugal impetus given off by the driving pulley would, but for the check from its own endlessness, throw the rope far above the horizontal plane. These two opposing forces combine to create a wave-like motion which is intensified in proportion to its slackness or the erratic power applied, until, as before mentioned, there is danger of the ropes leaping the grooves and so threatening the safety of both machinery and attendant. In forward driving, a rope curves in two opposite directions in descending from and ascending to the pulleys, whereas, in back driven ropes, the curve is in the same direction, and therefore renders no assistance whatever to undulatory motion. It is of course necessary to make the usual allowance for loss of frictional power upon the pulley between over and under driven ropes. In upward driving, such as largely prevails in our cotton mills, this tendency is effectually bridled by forcing the rope to run against, instead of over the pulley.

(To be continued).

THE CORNWALL BRIDGE DISASTER.

The fall of two spans of the New York & Ottawa Railway bridge over the United States channel of the St. Lawrence river, near Cornwall, Ont., has roused a great deal of interest both from the magnitude of the disaster and its unusual nature. The number of men killed in the accident is 15, while 16 were seriously injured. At the time of the accident the erection of both the fallen spans had been practically completed, and under one the falsework had been removed. On the other span the workmen had begun to take down the traveler, but most of them were working on the floor of the bridge when the accident occurred.

Principal interest, of course, centres in the construction of the pier which went down with the two spans. As the accident occurred on the United States side of the river, the Engineering News, New York, has made a thorough investigation of the subject, and we reproduce the data it gives: The river at the site of the pier is about 35 feet deep, and has a swift current, said to be about 5 to 8 miles per hour. The river bottom is a clay hard-pan in which are imbedded boulders, many of them of large size. The pier was founded by sinking a timber crib 18 feet wide, 62 feet long and 38 feet in height, and filling it with concrete deposited under water by buckets arranged to empty automatically on striking the bottom. The anchoring and sinking of this large crib in the deep water and swift current was a task of great difficulty. To accomplish it a small crib filled with stone was sunk up-stream to serve as an anchorage and a 3-inch steel cable was led from this to the pier crib, which was also supported by a barge on each side. Cables led to the river bank were used to swing the crib in the stream till it was in the correct position.



The swift current made it impossible to examine the bottom by divers before sinking the crib. Soundings were taken over the site of the crib, however, and the crib bottom was scored to correspond to the depth thus obtained. After the crib was down divers went down inside and obtained samples of the bottom, which was deemed satisfactory by the engineer, and the work of concreting began. The first concrete laid, to the amount of about 50 cubic yards, was deposited in bags, all of which were placed by divers around the sides of the crib. The remainder of the concrete was then deposited from a bucket holding about 1 cubic yard, arranged to dump automatically on contact with the bottom. The concrete was deposited in successive layers of about 18 inches over the whole area of the crib, and divers reported it as setting satisfactorily. The concrete was mixed by hand in the proportions of 1, 2 and 5, using Glen's Falls Portland cement. It may be said here that the crib itself was built of 12-inch timbers, drift-bolted together, cross-ties of the same size were inserted at 10 feet intervals, the vertical spacing being about 4 feet.

The concrete was carried up to a point 4 feet below water level, and was then pumped dry, the top of the crib projecting above the water forming a coffer-dam. The top of the concrete appeared in good condition, and upon it the masonry was started. Two courses were laid and then work was shut down for the winter, all the above-described work having been carried out last fall. During the winter the pier was subjected to heavy ice pressure, which, as most engineers know, is a severe test of any pier built in the swift current of the St. Lawrence; but it was not moved. Early in the spring, we are informed, it was struck by a heavy timber raft, which was broken up by the collision, and the pier showed no injury.

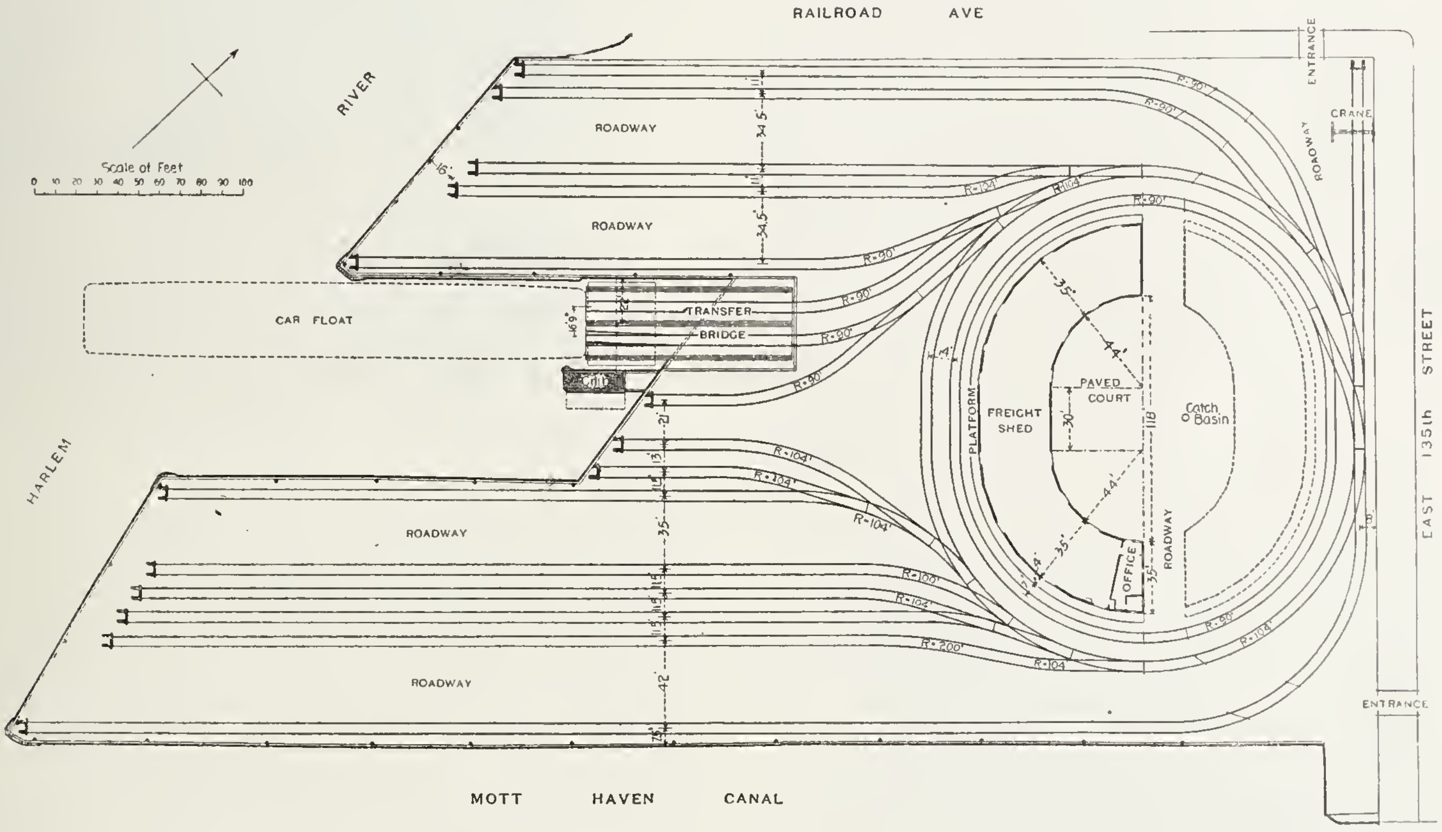
Work on the piers was resumed in the spring and they were built up to their full height of about 35 feet above the water, making the total height about 70 feet from the river bed to the pier coping. The masonry of the piers was rock-faced ashlar, with a backing of Portland cement concrete.

The specifications and working drawings for the bridge were made under direction of F. D. Anthony, chief engineer of the New York & Ottawa Railway Co., and were approved by A. A. Stuart, M. Am. Soc. C. E., now engineer of the Degnon-McLean Construction Co., of New York, who was consulting engineer to the railway company. They were also approved by the Canadian Government engineers.

The accompanying illustration reproduced from The Engineering News will be examined with interest. The north end of each span is in each case the fixed end. Thus on Pier 2, which fell, the channel span rested on expansion rollers, while the shore span, which still had the falsework under it, was anchored to the coping. The channel span turned partly on its side in falling, and its end-shoe is now about 25 feet south of Pier 3, on which it formerly rested. The shore span carried the falsework down with it, and, falling into shallow water, made a tangled mass of wreckage, as shown in the illustration.

A NOVEL CITY FREIGHT YARD.*

The illustration of the terminal freight yard of the Harlem Transfer Co., at Harlem River, New York City, shows a novel and efficient solution of the difficult problem of developing a railroad freight yard with suitable switching facilities within the narrow confines and comparatively small space of a city block. This unique and original plan was designed by Walter G. Berg, M. Am. Soc. C. E. Construction began last April, and the terminal was formally opened July 5, and is in successful operation.



FREIGHT YARD OF THE HARLEM TRANSFER COMPANY, 135TH STREET, NEW YORK CITY

The Harlem Transfer Co. is a corporation formed by several New York capitalists to establish a railroad freight receiving and delivery station for the Harlem River district of the city, following the general tendency to bring the cars nearer to the shipper and receiver of freight. While the company has made close traffic arrangements with the Erie Railroad, it is a strictly independent company and freight is to be handled from and to other railroads. Lighterage and wharfage business will also be handled to a limited extent. The scheme for the establishment of this yard was originated by and the work carried out under the supervision of J. C. Watson, the present general manager of the company. The yard is situated on the northeast side of the Harlem River, about half way between the Third Avenue and the Madison Avenue bridges, and covers the block bounded by East 135th street, the Mott Haven Canal, the Harlem River, and Railroad Avenue east of the New York Central. The block has a general width of about 330 feet and an average depth of 540 feet from 135th street to the river. The property was bulkheaded and filled in at different times in the past prior to its purchase and had a slip 100 feet wide and 200 feet long, as shown on the plan.

The problem offered was to develop the property for receiving and delivering carload or package freight, the cars to be transferred on the usual railroad car transfer boat, operating in connection with transfer bridges, to or from any of the railroad trunk line terminals on New York harbor. The standard three-track transfer car float, built for the Harlem Transfer Co., is 35 feet 6 inches by 240 feet in size, and has a track standing capacity for seventeen cars. In order to keep the outer end of the boat, when tied up to the bridge, within the proper limits beyond the bulkhead line, the shore end of the bridge had to be placed within 280 feet of the line of 135th street. Thus the development of the track system was confined to a space 280 feet ahead of the bridge and about 330 feet in width.

The leading feature of the design is the loop track, or full-circle switching track, from which all side tracks and connections start. All switching operations are absolutely positive, as there is no possibility of the engine getting pocketed. In some operations the engine takes hold of the cars only once; in other cases the engine cuts loose from the head of the string of cars and runs around and takes hold of the tail of the train.

A short tangent inserted in the loop track allows a switch to be taken out on the inside of the curve leading to an interior circular track as a standing track for a circular or annular freight house with an interior courtyard for teams. By this method the space inside of the circle is not only fully utilized, but ground space is actually saved. In the usual freight house layout there is considerable lost space between the wagon doors on the wagon delivery side of the house, as the spacing is generally made to correspond to the spacing of the car delivery doors on the opposite side of the house. In the plan presented, the car delivery doors correspond to a spacing of 40 feet between car doors, whereas the corresponding spacing of the wagon delivery doors is only about 20 feet. There is also an increase in track frontage of the building for a given floor surface. Thus, the half-circle freight house in the plan, as now built, has a car frontage of eight cars, whereas the actual average length of the house is only 240 feet, corresponding to only six cars.

The circular switching track and the interior radial freight house, with the inside courtyard for teams, in connection with the apparent simplicity of the track system, are the prominent features of the design. Otherwise the details are the usual ones for similar first-class work. The freight shed is an iron frame single story building, 35 feet wide, on brick piers, sheathed with corrugated iron and roofed with tar felt and gravel. The transfer bridge is a regular three-truss wooden railroad transfer bridge, 100 feet long, the shore seat resting on a pile foundation and the sea end on a wooden pontoon, 40 feet by 32 feet by 8 feet. All the wagon roads are paved with block pavements and the trackwork is of the usual grade. The rails are 70 lbs., switches of the Wharton split spring pattern, 10 feet long, ground-throw switchsands, frogs of the bolted and filled pattern, oak ties at switches and on curves, yellow pine ties on tangents. The ballast for the track and the bed under the paving is hard coal cinder. Finally, attention should be called to the important feature of the sharp curves utilized. The sharpest curves have a radius of 90 feet, while the "light" curves have 104 feet radius. These radii correspond, approximately, to No. 3 and No. 3 1-3 frogs. The gauge of track on curves is spread to 4 feet 9 inches, and the outside rail elevated 2 inches. The switching engine is a Baldwin 4-wheel enclosed tank dummy locomotive, 6 feet 6 inches wheel base, 44 inch wheels, 17 inch by 24 inch cylinders, and weighing, fully loaded, about 90,000 lbs. It is 27 feet long over all.

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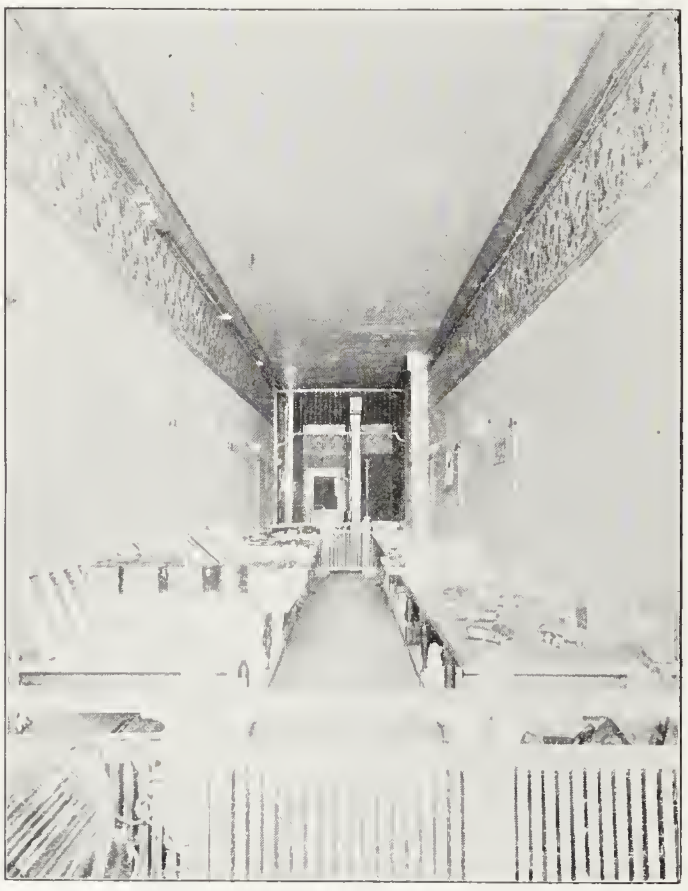
*Printed from Railroad Gazette, New York, July 29, 1898.

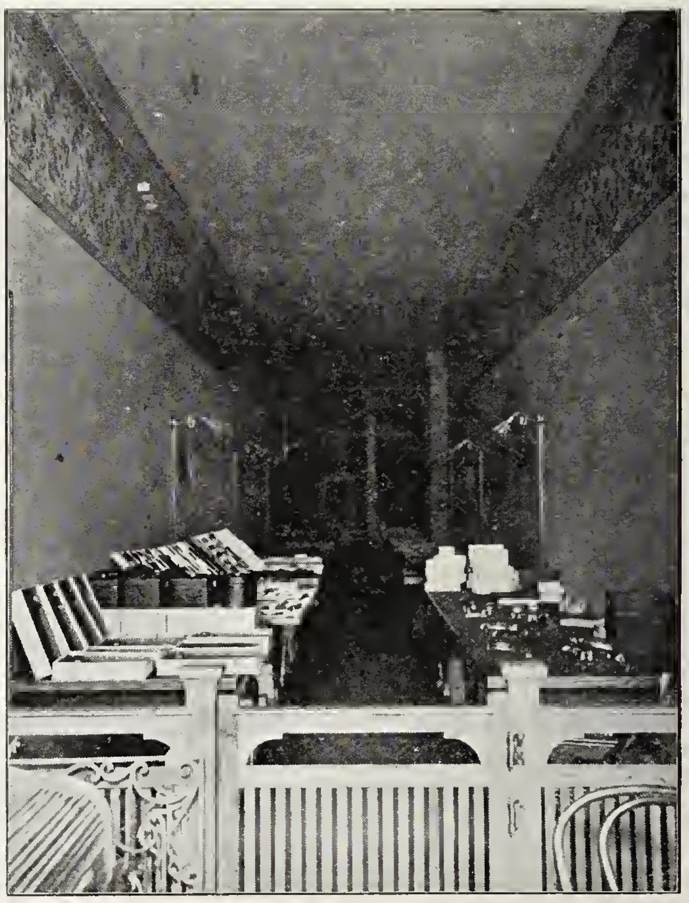
The use of these heavy curves at this terminal and the fact that heavier curves (even as small as 76 feet radius) are in use at the Brooklyn terminals of the Brooklyn Wharf & Warehouse Co. and at the Greenpoint terminal of L. M. Palmer, may perhaps serve as an object lesson to railroad companies, as to what can be done, if necessary, when confronted by confined and cramped conditions. Cars, especially with different kinds of couplers, will not couple readily on the heaviest curves mentioned, but special long links are provided for this purpose. As far as cars are concerned, however, there is no difficulty in passing them around these curves, naturally at slow speed, the elevating of the outside rail being an important track detail. Of course, a special switching engine with short wheel-base is necessary. The contractors for the work at the Harlem yard were George W. Rogers & Co., of New York City, for the transfer bridge and dock work; and Sandford & Stillman Co., of Jersey City, for the freight house, grading, paving and track work. Mr. George F. Morse prepared the detailed plans under Mr. Berg's supervision.

FIRE-PROOF CONSTRUCTION WITH LUXFER PRISMS.

One of the most valuable features developed in the manufacture and use of Luxfer Prisms is the discovery, which the owners have just announced, that a window of Luxfer Prisms glazed in copper by the electrolytic process, is absolutely fireproof. By an experiment carried on in the presence of a number of Fire Underwriters and city officials in Chicago recently, panels of Luxfer Prisms were heated in an open fire until they were red hot throughout; then the hose was turned on, and the fire extinguished, and the red-hot prisms drenched with water, the result was that the glass prisms were crackled into millions of pieces, but were securely held in place by the copper ribbons throughout the panels. It might be explained that the Luxfer Prisms are made of sections of glass, 4x4 inches, glazed together with copper ribbons between the sections, and the whole panel cemented together and strengthened by an electro-deposition of copper. In this way it was shown that a panel of Luxfer Prisms may be exposed to intense heat; in that condition further exposed to drenching with water, and still retain their strength and operate as a complete barrier to flames passing through a window.



Another feature of the use of Luxfer Prisms is the fact that light can be carried into large interiors from windows, instead of through skylights and light wells. Light wells are a great hazard in any building, and any device that will enable a builder to do away with them is of immense value. As a practical exemplification of this, we can instance the case of the building occupied by Michie & Co., grocers, Toronto. In their store—the central portion was lighted by a large light well and skylight—a fire broke out on an upper flat and the flames were carried downwards, strange to say, through the light well, and destroyed valuable goods on the lower floors. Naturally they were anxious to remedy such a hazard, and on looking into the merits of Luxfer Prisms decided to have them placed in the front and rear windows, and see if they could get enough light without the light well. The installation was made and the light well closed up completely by a steel clad ceiling. The store is better lighted in every respect, and the risk of the light well is entirely removed. A feature of this character is of great practical value and well worth consideration on the part of engineers and architects in designing buildings, to have a minimum of risk from fire. Apart from their value as above described Luxfer Prisms are stated to be very useful in carrying light into dark places—as may be seen in the accompanying cuts. These are made from two photographs of the interior of a large sample room, 100 feet long, lighted only by a large plate glass window at the front. The dark cut shows the appearance of the room without the prisms, and the light cut shows the effect of the prisms in lighting the back part of the room. A demonstration like this tells its own story.



TARRED MACADAM FOR ROADS.

A. H. Campbell, city engineer of Canterbury, England, is an advocate of tarred macadam roads, and has recently been giving his experiences to the British Association of Municipal and County Engineers. Broken lime-stone is warmed either by building it up in alternate layers with coke or by building it in a cone closed at the top and fired in the middle. About 54 bushels of coke are consumed in a stack of 60 cubic yards. Both these methods cause loss as some stone is too violently heated and so disintegrates. An oven or kiln is to be preferred as the heating is more equable.

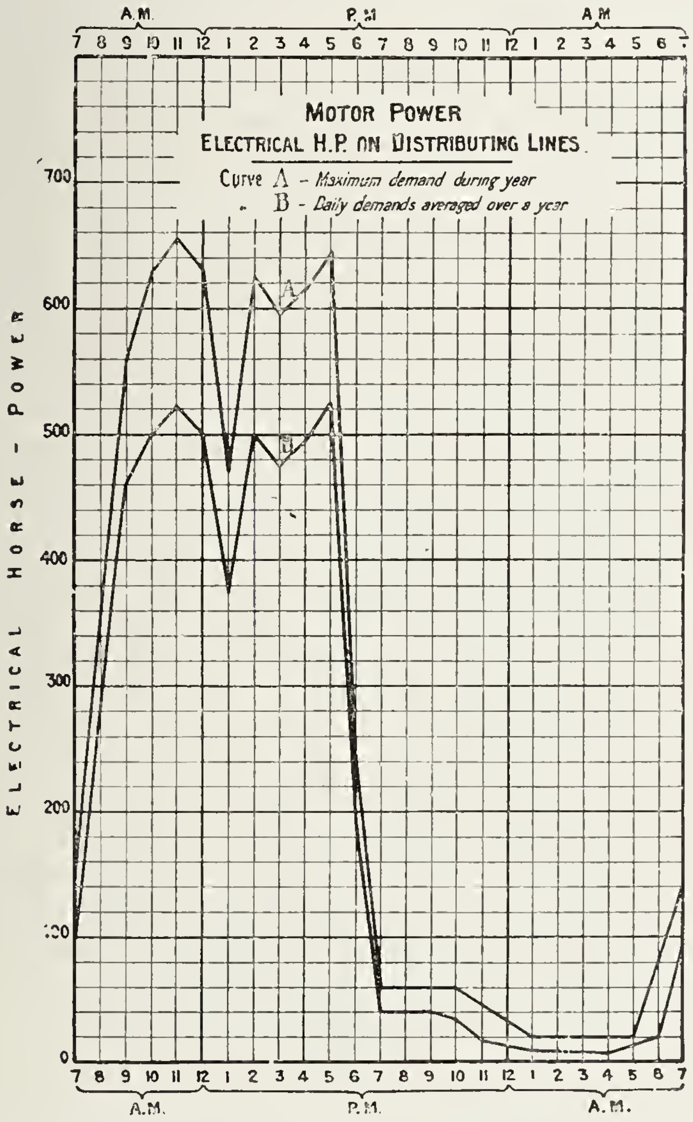
The temperature of the stone when the tar is applied should be such that the palm of the hand can bear it with comfort. If it is too hot the tar will be destroyed as a binder, and if too cold it will be used so thick as to soften in very warm weather. The hot stone, when ready for mixing, is screened into material of three sizes, 1 to 2 inches for the body, ½ to 1 inch for the intermediate coat, and ¼ to ½ inch for the top dressing. The coarsest material is used in a layer 3 to 4 inches thick, the intermediate size forms a coat of about three-fourths of an inch, and the top dressing is used in the thinnest layer possible, with a view to filling all interstices. Afterward a dressing of ¼-inch and smaller granite screenings is scattered broadcast, and the traffic at once allowed on the road to work this top dressing into the tarred material. Each of the layers is rolled separately with a 10-ton roller. It should not be laid in cold weather. The tar used should be of good quality, and heat should be applied long enough to secure great tenacity, but ought not to be carried so far as to make the pitch brittle. Mr. Campbell's practice is to boil the tar in kettles holding 50 imperial gallons for three or four hours, and then add half a bucketful of pitch and boil a short time longer. The cost of such a roadway varies with the price of material and the cost of labor. Mr. Campbell says his experience has been that a four to four and a half inch layer costs, for material alone, 36 cents per square yard, to which he adds 18 cents for excavating for the pavement, 20 cents for broken brick ballast, 18 cents for labor, 6 cents for rolling and 10 cents for contingencies, making the total cost $1.08 per square yard. This road is capable of bearing the heaviest country traffic, with an outlay of probably 4 cents a square yard for repairs, and is regarded as good for seven years.

ELECTRICAL POWER TRANSMISSIONS.*

BY R. A ROSS, E.E . M. CAN. SOC. C.E.

(Concluded from June Issue).

The load for all classes of demands is given to the last curve, which is formed from the others, and shows the period of the greatest station activity to be about six p. m. It is evident that apparatus must be installed to meet this maximum demand, while the average output could be met by a much smaller plant. The interest and depreciation charges on plant, which forms such a considerable percentage of the cost of the output, is a constant, no matter what that output may be, so that, when it is possible to fill up the hollows in the curve by the sale of additional power during periods of light load, which shall not be operative during the period of heavy demand, the cost of this addition is only that of additional coal in steam stations, and in water powers is nothing, and for this reason may be disposed of at low rates. The table below illustrates the ratio of plant installed to the output column, one giving the average output per hour figured from the curves for a year, and column two the plant installed to meet maximum demands, while the third shows the ratio between them.



	Incandescent	Arc.	Motor Power.	Street Ry.	Total.
Average E. H. P., per hour	604	650	218	2,430	3,902
Max. E. H. P. required . .	2,925	1,300	656	6,450	11,331
Ratio output to capacity. .	20.6%	50%	33.3%	37.7%	34.4%

It will be seen that the output is only about one-third of that possible with the plant that must be installed. To dispose of the remaining two-thirds is the ambition of every station manager. It is just here that the storage battery finds its best field in steam station, but in waterpower plants it has no place unless the plant be loaded to its full capacity, and an increase is desired which the water available will not admit of. As an illustration of what is to be expected, the above case is useful, but so simple a case seldom occurs in practice, as instead of having the curves of actual demand, the engineer usually has to draw upon his educated imagination for these, guided by his experience with similar plants. Having determined the amount required for the various demands, and fixed upon the best method of distribution to meet those demands, the problem of the transmission may be taken up intelligently point by point.

Considering the direct current as out of the question for large transmission purposes, three different alternating systems present themselves, namely, single, two and three phase. The first we are thoroughly familiar with, owing to its use in the purely lighting stations where it is entirely satisfactory, but when it is necessary to distribute power for motor purposes it fails owing to the fact chiefly that single phase motors while practicable are not found suitable in operation as they are not readily started from rest. The question therefore hinges upon the point of relative superiority of the two and three phase systems. So far as apparatus is concerned, these two systems are about on a par for all practical purposes when designed for the same conditions of operation, but for the line the three phase has the best of the argument, the transmission copper being reduced 25%. This point of superiority, however, loses much of its effect, for it is possible to use two phase apparatus at both ends of the line, and by means of suitable transformers change from two to three phase for the transmission, in which case the capacity of the transformers used must be slightly increased, as some of the copper is partially inactive when coupled up for change of phase. For this reason the three phase will be adopted in the case under consideration as being probably the cheaper in first cost and equal in efficiency.

As the copper in the circuit varies inversely as the square of the voltage for the same loss and distance, the advantage of high voltage becomes apparent. Conversely with the same distance and copper, the loss in line may be reduced in proportion to the square of the proportionate increase, or the distance may be increased directly as the increase, and any combination of these may be attained by simply raising the voltage. On the other hand, the apparatus installed must be designed to resist the effects of the increase on the insulation, and greater precautions are necessary to maintain it in operative condition. The cost will also be somewhat greater where especially high voltages are used. The highest voltage in practical operation at the present time, so far as I am aware, is at Ogden, Utah, where 16,000 is used with raising transformers. The highest generated directly on the machine without the aid of transformers is 12,000 at the Chambly plant. There are several now building, however, which contemplate a line voltage of 20,000, and we may expect to see this figure increased from time to time as methods of insulation improve. It is well to remember that the apparatus will be called upon to resist much more than the normal pressure, owing to conditions of load, to opening of circuits under load, and to lightning, so that a large factor of safety is essential where high voltage is desired.

In former years a high periodicity of 120 to 133 per second was general, being suitable for lighting purposes, and by reason of the high period, transformer costs were low. With the advent of the alternating motor and of long transmission lines the periodicity dropped to 60, which is now the standard in America. In Europe, however, the tendency is to go even lower, and each maker of apparatus appears to have his own standard. The lowest possible, where incandescent lighting is to be done, is 25, for at this alternation the fluctuations are just visible in the light. The effects of lowering the periodicity are to decrease induction effects, which are always objectionable, simplify and cheapen the motor equipment and to increase somewhat the cost of transformers. It would appear that for general transmission work, which involves the use of much power for motors, that a lower alternation would have met the case speeds better, but as 60 periods has been universally adopted on this continent it will probably be maintained for some time.

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*From a paper read before the Canadian Society of Civil Engineers.

(To be continued.)

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

(Continued from last issue).

All ironwork, columns and pillars, beams and girders, should be "fire-proofed," i.e., covered with at least 4 inches of incombustible material, terra-cotta or brick. At the floor, and for a height of 4 feet in mercantile buildings, a metal guard should be employed to prevent the column from being stripped by collisions with rolling trucks for moving merchandise. It ought to be unnecessary to suggest that wooden lagging should, under no circumstances, be used to cover iron, were it not for the fact that in one of the largest and most costly dry-goods stores in New York, the "fire-proof" covering of the iron columns, which had been seriously damaged by trucks, was being systematically removed in order to substitute wooden lagging, when the fault was, fortunately, detected by an inspector of the underwriters. Four inches of good brick work is a good covering, but porous terra-cotta, or even wire lath and plaster, may prove effective. Where wire lath and plaster is used, the column should first be wrapped with quarter-inch asbestos, bound with wire. This would prove reliable and inexpensive.

A notable instance, showing the necessity of protecting ironwork with incombustible material, and the danger of expansion in long lines of iron girders or beams, was that of the destruction of a "fire-proof" spinning mill at Burnley, England, recently. This mill was 210 feet long by 120 feet wide, six cast-iron girders of the Hodgkinson type, each 20 feet long, spanned the 120 feet width, being bolted to cast-iron columns, and carrying, in turn, cross girders of wrought iron. The expansion of these 120 feet girders (they were unprotected) resulted in the disruption of the floor and the destruction of the mill. The cast-iron columns, being unprotected, collapsed under fire and water. The floors were 10 feet, 6 inches bays. As already stated, beams should not be spaced over 5 feet on centres. Wider spacing results in weak arches, liable to be buckled out by heat or punched through by the falling of safes or of other heavy articles from upper floors. The probability is, that if the 20 foot girders in this building had been arranged with provision for expansion, and all the ironwork had been thoroughly protected with "fire-proof" material, little damage would have been done. The effect, if the floors had been loaded with combustible merchandise, would have been more rapid. There was little wood to burn in the contents of the spinning mill, and yet the destruction was thorough. Such buildings with uncovered ironwork are more dangerous than those of heavy wood construction, in which the timbers are 12 inches or more in diameter, and not more than five stories in height. A properly constructed building with protected iron, however, is of course superior to any other form of building. Experienced firemen are afraid to enter buildings supported by iron columns unless they are thoroughly "fire-proofed," as they are liable to snap without warning under the influence of fire and water, whereas wooden posts burn slowly and give notice of collapse. They will stand a severe fire without being charred for more than two inches of their surface. In mercantile buildings and factories, beams, as already stated, ought not to be spaced more than 5 feet apart, no matter what kind of arch is employed; and while many experts claim that a heavy iron I-beam, thoroughly encased in "fire-proof" material on three sides, and having only its soffit or under side exposed, would not be expanded enough by the heat of a fire to cause its collapse, it is best to take no chances, but to protect the under side with "fire-proof" material, which can be cheaply applied with wire lath and plaster, or by having the skew-backs of the terra-cotta floor fillings extended below the soffit or bottom flange of the beam, and made with lips for protecting the iron.

It is a mistake, in my judgment, to dispense with tie-rods, even with the kinds of arches which employ wire cables or other metal ties. The claim is made that these act as tie-rods, but it should be remembered that they cannot be relied on during construction, when derricks for hoisting iron beams and other materials are resting on the girders. Dangerous lateral movements and twistings of the structure may be the result of want of rigidity, which can only be obtained by using tie-rods.

It is my opinion—but there are many who entertain a different one—that the old-fashioned brick arch is the most reliable for resisting fire; that next to this in safety stands the porous terra-cotta segmental arch, with end construction, i. e., the blocks or separate pieces placed end to end between the beams, instead of side by side, in what is known as "side construction." This is said to be stronger than side construction. It is claimed by many experts that porous terra-cotta is a better non-conductor than brick on account of its interior air spaces. The arch should not be less than 4 inches thick, having a rise of at least 1¼ inches to each foot of span between the beams, and there should be a covering of good Portland cement and gravel concrete over this to ensure a waterproof floor. Cinder filling will burn—crushed slag from blast furnaces is better, but the Portland cement concrete should not be omitted for waterproofing purposes. There are many patent floor arches for filling between I-beams which have great merit when properly put in, but I doubt if any of them are equal to the two I have named, and it should always be borne in mind that when employed they should be inserted with the same care with which they are prepared for tests. This is almost equally true, however, as regards brick and burnt-clay arches, also. There is less likelihood of poor installation work, however, with brick arches or segmental arches of porous terra-cotta or burnt clay. Arches should be laid in Portland cement, not lime mortar. Under no circumstances should they be laid in freezing weather, and where concrete is used the broken stone or gravel should be carefully washed, and the cement should be of the best quality.

It is of great importance that the floors of all buildings should be waterproof, in order that the volume of water thrown by the fire department to extinguish a fire may be carried off without injury to merchandise on the floors below. Neglect of these precautions is criminal in view of their simplicity and inexpensiveness. After the arches have been set between the I-beams they should be covered, for at least a thickness of 1 inch, with the best Portland cement concrete, carefully laid, so that all water will run to the sides of the building and be carried off by water vents or scuppers, which may be arranged with pipes through the walls, having a check-valve which would prevent the influx of cold air and yet admit of the out-flow of water. All ducts for carrying steam, gas, and other pipes and electric conduits should be protected with a metal sleeve going above the surface of the floor, and the space between and around the pipes should be filled in closely with mineral wool, asbestos, or some other expansive and "fire-proof" material to cut off draughts and flame. Floor boards should be dispensed with, if possible, and asphalt or concrete employed instead. It is hardly practicable in office buildings, however, to dispense with wooden floors. Wherever used they should be so laid, especially in mercantile or manufacturing buildings, that there is no air space to supply a passage for flame and to form a harborage for rats and mice, to which these vermin can carry matches, oily waste, or other combustible material, liable to be ignited by steam pipes or by spontaneous combustion. Various processes, "electric," so-called and otherwise, have been patented for "fire-proofing" wood. They undoubtedly increase the fire-resisting properties of wood for interim trim, window casings, etc. Whether or not they impair the durability of wood is a matter as to which I am not yet informed, and I doubt if sufficient time has elapsed for a proper test. The United States navy has made trials of "fire-proof" woodwork—with what success I am not informed.

The enclosures of all ventilating shafts, for water-closets, etc., light shafts, and dumb-waiter shafts should be constructed in the same substantial manner as freight elevator shafts. It is a mistake to use thin plaster board or plaster with dovetailed, or other metal, lath, etc. No enclosure should be relied upon less than 4 inches in thickness, well braced with an angle iron, but brick walls are best, especially in buildings over 60 feet high. The lights should be of wire glass, set in metal framework, and ventilators should have metal louvers arranged to secure ventilation, but not to increase a draught. Slats should be riveted, not soldered, to metal framework, and the metal framework should flange well over the "fire-proof" material of shaft on both sides. It is possible to finish tin-covered "fire-proof" doors with wooden trim so as to be ornamental, with bead panel-work, etc.

(*To be continued.*)

CORUNDUM.*

The band of rocks of Laurentian age in the northern part of the county of Hastings and the southern part of the county of Renfrew, in which corundum has been found, may be said to be made up of three important kinds, gneiss, syenite and quartz pegmatite. What appears to be the oldest rock in the belt is dark colored and more or less gneissoid in structure. It is in all probability a metamorphosed igneous rock and might now be called gabbro-gneiss. In megascopic character it is pretty uniform throughout the belt. The dark colored minerals which predominate in it are horn-blende and biotite, of which the former is in greater quantity. The other generally most abundant constituent is plagioclase felspar, but in some cases the felspar, or the more basic varieties of it, is decomposed. The percentage of silica in the rock agrees with the view that it is an altered gabbro or gabbro-diorite. Several examinations were made of specimens from different parts of the belt and these range in percentage of silica from about 47 to 53. This gneiss, the oldest rock in the belt, is cut through by a series of dikes or masses, which consist largely of felspar or felspathoid minerals in which occurs the corundum. In some cases these dikes are light pink in color, while in other cases they are gray or white, depending on the color of the felspar, but the pink colored rock is less abundant than the other. These dikes are interesting in several respects.

Along the greater part of the strike of the dikes the rock has sometimes the character of coarse syenite, but in some cases it passes into nepheline syenite. In both varieties of rock corundum is found at times. Nepheline, a mineral which plays the part of a felspar in rocks, is a comparatively rare substance in many parts of the world. Some nepheline holding rocks when weathered have much the appearance of crystalline limestone, and are apt to be mistaken for this rock.

The most abundant constitutent in the group of igneous rocks in which corundum occurs is felspar, but this is replaced to a greater or less extent in some cases by the felspathoid mineral, nepheline. The other important constituents of this group of rocks, outside of corundum, are black mica, hornblende, which is sometimes represented by its very basic variety, hastingsite, and white mica. Quartz has never been observed by the writer in any hand specimen of rock taken from these dikes or masses. These dike rocks, if we leave out of consideration the occurrence of corundum in them, which of course lowers their acidity, may be described as syenites. Three or four varieties may be made of these. In some cases the rock is composed largely of felspar; at other times it contains mica or hornblende, and could then be called a mica or hornblende syenite; while, where the nepheline comes in, we have nepheline syenite. Magnetite is quite abundant at times. Pyrite is present in rare cases, and there is considerable variety of secondary minerals more or less micaceous in character, which have not as yet been worked out. Where the syenite occurs in association with garnetiferous rocks, as in the northeastern part of Raglan, it carries garnet. Crystals of zircon, some of which had a diameter of one-eighth of an inch, were found in the syenite at one locality in Dungannon. Sodalite is sometimes present in the nepheline syenite. As the syenite on analysis appears to contain only a trace of magnesia, the poorness of the rock in spinel, which so frequently accompanies corundum in other districts, is accounted for. In general it may be said that the corundum occurs more abundantly in the ordinary syenite than in the nepheline syenite, but the crystals of corundum are usually much better formed in the latter than in the former. The corundum-bearing dikes vary much in width, which is usually some feet. In one case the writer observed a clear and well defined dike on the side of a hill in the thirteenth concession of the township of Carlow, whose width was only 1¼ inches and which had corundum studded pretty thickly through it. Other well defined dikes had a width of five or six inches. There are many dikes similar in character to those in which corundum occurs which do not contain this mineral. It may be present in one part of a dike and absent in another. It is frequently seen to have segregated in lines or patches through the rock, causing the rock to be richer in some parts than in others. Both the nepheline syenite and what has here been called the ordinary syenite often occur in broad dikes or masses, and it would be possible for one not making a careful study of the district to conclude that these two rocks belonged to different periods of eruption, or possibly came from different magmas. Sometimes the one rock passes somewhat sharply into the other in the same dike or mass. In this case if the line of passage is obscured one would be apt to conclude that the rocks belonged to different periods of eruption. But we have an "ear-mark" as it were in the occurrence of corundum in both kinds of rocks which at once attracts attention and causes one to look further into the relations existing between them. Having found that the nepheline syenite passed into ordinary syenite, and vice versa, in some cases following along the strike, the writer made use of this knowledge in prospecting for corundum. If a mass of nepheline syenite containing no corundum were found, the dike or mass in which it occurred would be followed up with successful results in some cases, the corundum coming in when the nepheline became less abundant or absent. In the case of one broad dike or mass in the township of Lyndoch, coarse nepheline syenite was found outcropping at the road side. After following the dike for about a mile, until nepheline was no longer observed on the weathered surface of the rock, corundum was found. In the case of other dikes search was rewarded with success in the same way. In somewhat close association with the syenite dikes of the corundum belt in parts of the district is a light colored granite in which corundum was not found.

In addition to the syenite dikes and masses, which cut the dark colored gneiss, there is another set of dikes whose relation to both of these rocks is easily made out. These dikes are quartz pegmatites, or coarse granites, and are younger than the corundum-bearing dikes, which is shown by the fact that these latter dikes are often cut by them. The quartz pegmatites are usually light pink in color and resemble in general appearance some of the coarser pink varieties of the corundum-bearing dikes. These coarser varieties of the latter dikes may also be spoken of as pegmatites. The quartz-bearing dikes contain as essential constituents in addition to quartz, felspar, which is usually the most abundant mineral present, and hornblende, which is usually pretty badly decomposed. Magnetite is a frequent accessory mineral in these pegmatites. Two or three trap dikes were observed which appear to be of later origin than the corundum-bearing dikes, and probably also than the quartziferous dikes. Crystalline limestone, generally in small areas, was found in different parts of the district, but in no case was this rock seen to be cut by the corundum-bearing rocks. These areas of crystalline limestone may be considered as outliers over the fundamental gneiss, and were no doubt at one time connected and formed areas of considerable extent, but have been disconnected by denudation.

Corundum has been found occurring under different conditions in crystalline rocks. In some cases it is an original constituent of the rocks, i.e., it was formed at approximately the same time as the mass of the rocks in which it occurs. In other cases the mineral is of secondary origin, having crystallized out in the rocks at a later date than most of the material with which it is associated. Corundum occurs as an original constituent in different igneous rocks. In eastern Ontario it occurs, as has been stated, in syenite. In other countries it occurs in granite, basalt, andesite, trachyte and other igneous rocks. Corundum is found as a secondary constituent in various metamorphic rocks, having been produced in them through the agencies of alteration to which they have been subjected. In Eastern Ontario and other parts of the world, e.g., Burma, etc., it is found in crystalline limestone. Some of the best gem varieties of the mineral have been found in this rock. Rocks of all kinds carrying corundum are broken down through the action of the atmosphere and other agencies into gravel and sand, and hence the mineral is often found in loose deposits in the beds of streams and elsewhere. In these water deposits it is found associated with other mineral of high specific gravity, such as native gold and magnetite. Some of the foreign localities where the mineral occurs in economic quantities are those of North Carolina and Georgia, (corundum), Chester, Mass, (emery), and Montana, (gem varieties). A great part of the emery of commerce comes from Turkey and the Grecian Archipelago. Gem varieties are obtained from Burma and other parts of the world.

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*Extracted from the report of the Ontario Bureau of Mines 1898, Vol. VII., Part III.

The mineral corundum is one of the hardest natural substances known, being excelled in hardness only by the diamond. Its position in the scale of hardness arranged by Mohs, is between that of the topaz and diamond. As corundum is often more or less altered or changed into secondary minerals, mica, etc., care should be taken in selecting a specimen of this mineral for a test of its hardness to make use only of a specimen which shows no sign of alteration, and which appears to be free from impurities. As corundum is also somewhat brittle, care should be taken not to be deceived by the breaking of the mineral. A crystal of quartz with smooth surfaces is useful in distinguishing other hard minerals. As most minerals which have a hardness greater than that of quartz are comparatively rare, one has generally little difficulty by its use in determining whether a given specimen is corundum or not. A crystal of topaz is still more useful, and small crystals of this mineral can be obtained from mineral dealers at small cost. The prospector for corundum should also possess some typical specimens of the mineral for the purpose of comparing hardness and other characteristics.

Corundum is composed of the oxide of aluminium (Al_2O_3) but traces of the oxides of other metals are generally present as coloring materials. As in the cases of other minerals of non-metallic lustre, the color of corundum varies considerably. Sometimes the mineral is colorless or white, and at other times it is found possessing a blue, pink or red, brown, gray or other color. The relative weight of corundum compared with equal volumes of many other minerals is high. It has a specific gravity of about 4, i.e., it is four times as heavy as an equal volume of water, while felspar has a specific gravity of from 2.4 to 2.7 and quartz of 2.5 to 2.8. Its weight in hand specimens thus aids in its determination. Corundum crystallizes in what is known to mineralogists as the rhombohedral division of the hexagonal system. Well developed crystals are often somewhat long and narrow, tapering towards a point at either end. A cross section of a crystal is six sided. When the crystals are well developed they possess a number of planes at either end. Crystals of the mineral, however, from different localities differ considerably in form. The crystals of this mineral generally possess a well defined parting, or show a tendency to split readily in certain directions. On some of these parting surfaces two sets of very fine lines are generally distinguishable, dividing the surface into small four sided areas. Corundum is infusible before the blowpipe, but is slowly dissolved in borax and phosphor salt. It is not acted upon by acids. If finely pulverized the mineral takes on a blue color after heating with cobalt solution. There are three subdivisions of the species, to which the name corundum is given, recognized in the arts. These are: (1) Sapphire, which embraces the purer kinds of fine colors, transparent or translucent, which are useful as gems. These gem stones are given different names according to the colors as sapphire (blue), and ruby (red). (2) Corundum, which includes the non-transparent kinds of dark or dull colors. (3) Emery, which is a granular corundum, black or grayish black in color, and more or less intimately mixed with magnetite or haematite. Some varieties of corundum are among the most costly and highly prized gem stones. Corundum has been produced artificially in various ways, different compounds of aluminium being used for the purpose. In most cases these compounds are subjected to the action of other substances at a high temperature. It has been formed by the decomposition of aluminium chloride through the action of magnesium and water vapor in a closed tube; by the decomposition of potash alum by means of charcoal, and in other ways. Many other minerals and even rocks have been produced artifically in the laboratory, but in most cases the results obtained have been of little economic importance. An interesting artificial production of corundum, considered in connection with the occurrence of the mineral in eastern Ontario, in nepheline syenite, is that in which the mineral has been produced by dissolving allumina in melted nepheline, and allowing the molten mass to crystallize.

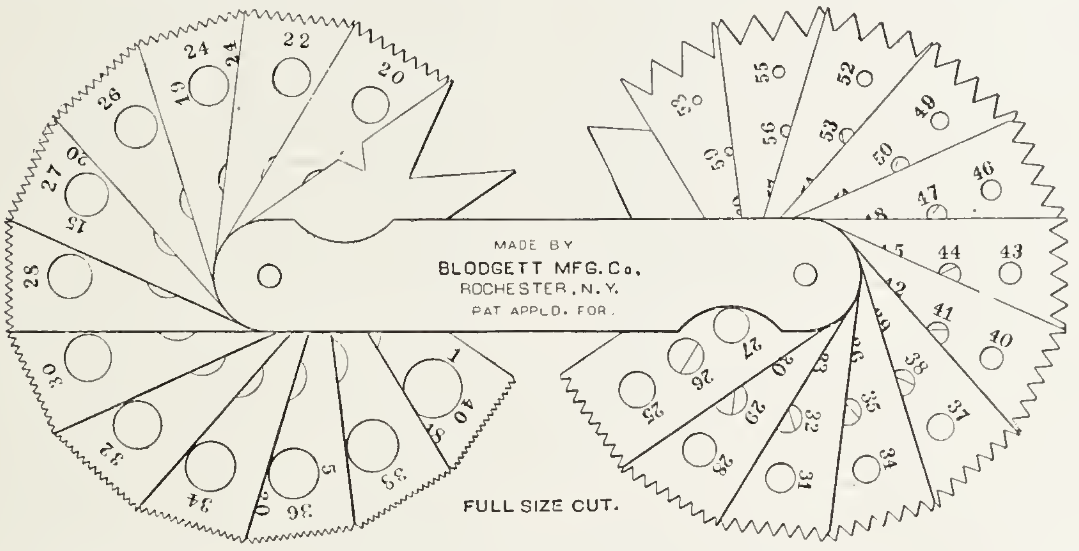
In commerce corundum and its varieties are divided into two classes, viz.: Gem stones and abrasive materials. The gem stone varieties have already been referred to. They are of comparatively rare occurrence, and when of high quality they are of great value. By the term "abrasive material" is understood a substance which is used for grinding or polishing purposes. Corundum proper and emery are used for this purpose. The powdered substance is made into "emery" wheels, the grains being cemented together by some suitable substance. The use of emery wheels in grinding down steel or other instruments is well known. Some of these wheels are moistened with water when being used, but others have to be used in the dry state, their cement not holding together after being wet. Emery is also used in the form of grains and powder. Corundum has been used in the production of aluminium, but as it is in such demand as an abrasive material it is too costly to be used as an ore of this metal. If its price were lower there would no doubt be a demand for it as an ore, on account of its generally being pretty pure and possessing such a high percentage of the metal. The uses of aluminum are being constantly extended. Many interesting results have been obtained with it in connection with alloys, one of which is of particular interest in Ontario. It is stated that of the alloys so far examined the one which seems to give the best present results and the greatest promise, is that with nickel. The addition of a few per cent. only of nickel to aluminium greatly enhances the strength and toughness of the metal, and adds to its brilliancy without adding materially to its weight. The metallurgy of aluminium offers a very inviting field for research. Alumina in a suitable form for the extraction of the metal is said to sell at about 4½ cents per pound, or two tons of alumina, which represent about one ton of the metal, are worth about $180. As aluminum sells at $700 per ton there would seem to be a considerable chance for the discovery of methods of extraction whereby the metal could be produced more cheaply. Moreover it does not seem altogether unlikely that methods of extraction will be discovered whereby a less pure alumina than that demanded by manufacturers at present can be used for the production of the metal.

Different varieties of corundum were known to the ancients, who made use of it as a gem and as an abrasive material. The emery of the Grecian islands has long been known. It is thought by some that the native races of America, judging from certain carvings on rocks, have made use of the mineral. In the Geology of Canada, 1863, reference is made as has been already stated, to the occurrence of the mineral in the township of North Burgess, and to its occurrence with other minerals in the auriferous sands of the Chaudiere. No other occurrence of the mineral in Canada was made public until the report of its occurrence in the township of Carlow in October, 1896. This may be accounted for by the fact that most people are attracted only by minerals of a metallic lustre, and so pass over those of a "stony" nature. If a part of the energy expended by prospectors in this Province in search for the precious metal had been employed in hunting for other substances, it seems not unlikely that many more valuable and interesting minerals would have been found. It is difficult to get reliable statistics on the production and consumption of corundum. In the Mineral Resources of the United States, 1895 and 1896, a Government publication, it is stated that "The producers of both emery and corundum are averse to giving publicity to their business, and in order to maintain the confidential nature of the statistics the production of the two minerals is stated together." The present selling price of North Carolina corundum quoted in The Engineering and Mining Journal of New York is from $140 to $200 a ton, being at the rate of 7 to 10 cents per pound. Emery is quoted at 1½ to 5½ cents per pound. The corundum and emery produced in the United States in 1895 is stated to have been 2,102 short tons, valued at $105,256, and in 1896 the production was 2,120 short tons valued at $113,246. "The corundum used in the United States is exclusively of domestic production. Emery is imported from Turkey and the island of Naxos, one of the Cyclades group in the Grecian archipelago." The imports of emery in 1895 were valued at $133,038, and in 1896 they had a value of $148,231. The imports of emery into Canada for the last ten years have averaged about $15,000 annually.

The latest advices from Michipicoten, Ont., are to the effect that there is a rush of miners and prospectors in that region again this fall. Several rich strikes have recently been made on the north shore of Lake Wawa.

BLODGETT'S COMBINATION TWIST DRILL, THREAD PITCH, CENTRE AND TAP DRILL GAUGE.

It is with pleasure we present this brief description of one of the most convenient machinists' tools modern ingenuity has developed. This gauge contains the sixty sizes of twist drills from No. 1 to 60; twenty-four thread pitches from 6 to 40; ten tap drill sizes from 2-56 to 18-18; also the centre gauge, and is so constructed that its weight is less than two ounces, making it no larger or heavier than the ordinary pocket knife. This is claimed to be the only convenient pocket drill gauge on the market, as the old style is too heavy to carry. It is made of the best obtainable steel for this purpose, and is case hardened to prevent the holes from wearing by use. The holes are broached to Brown & Sharp's standard and will be found accurate. The blades of this gauge are utilized for two purposes: the holes being made in the blades for the drills, and the thread pitches cut on the ends, thereby preventing the necessity of carrying an extra tool for that purpose. The numbers indicating the pitches are stamped on the back side of the blade, crosswise, against the thread, so that the desired pitch is easily found. Machinists, like other people, cannot remember every detail, and are often at a loss to know what size hole to drill for a machine screw tap, to get a full depth thread, and, at the same time, to give a sufficient amount of clearance to prevent breaking the tap, for they have learned that a tap will not drill. Ten sizes, ranging from 2-56 to 18-18, are stamped on the back side of the blades, against the proper size drill for that purpose. This gauge is divided into two parts, male and female, which are placed in the back of the gauge and are easily found when wanted. The ordinary centre gauge cannot be carried in the pocket with safety, as the points will soon puncture, and work its way out. No pains have been spared by the manufacturers to make it a perfect, complete and condensed tool. This gauge will be appreciated by those using small tools, as some one of the combined features is in almost constant demand in the large variety of fine machinists' work. For price, etc., see the Aikenhead Hardware Co.'s advertisement on page v. of this issue of The Canadian Engineer.



FULL SIZE CUT.

THE MARINE ENGINES OF THE GREAT LAKES.

Some 1,300 steamers on the lakes have been examined for the Great Lakes Register of Chicago in the past two years. J. C. Coffin has just published a summary of the results of the work, from which we make a few extracts: Of the 1,300 odd vessels surveyed, says Mr. Coffin, we have found 1,150 to be propellers, and a trifle over 50 to be paddle, or side-wheel propellers; the balance being schooners and tow barges, which were equipped with boilers and steam pumps, or hoisting and steering machinery. Of those fitted with screw propellers, we have found that 960 had solid cast wheels, 6 of them being of bronze, 8 of steel and 946 of cast iron; 185 of them had sectional wheels, one of them being bronze, 6 steel and 178 cast iron. Of the entire number, 1,060 of these propeller wheels were fitted on the tail shaft with straight bore and key, while only 74 were fitted on a taper end with feather and nut, the latter arrangement being more modern and considered by most engineers to be the best way of fitting propellers on the shafts. Of the paddle-wheels, we have found 23 to be fitted with feathering floats, and 29 with solid floats. The h.p. non-condensing engine, our earliest type, held the supremacy in numbers up to the end of the decade, 1880 to 1890; this is accounted for in some degree during the latter part of this period, by the fact that there were many tugs and small boats built. The h.p. condensing engine appears but little upon the lakes, there being a total of only 25 in existence. The steeple compound engine had an early start, 22 of them now in existence, having been built earlier than 1870, 62 during the next ten years, and 89 during the period from 1880 to 1890. This type then gave way to the fore and aft compound type and triple expansion type. Of the fore and aft compound type we have five engines built earlier than 1870. This type also reached the height of its popularity during the years 1880 to 1890, and then gave way rapidly to the triple-expansion type, which makes its first appearance during this term with 67 examples, and which has held its supremacy with 147 engines built since 1890. The first quadruple expansion engine was built in 1889, and since that date there have been six vessels equipped with this type of engine, and there are several of this type now under construction. Of the paddle-wheel boats, you will note that 33 engines are of the common and well-known walking-beam type, while 19 are either horizontal or inclined engines.

It is interesting to note the changes which have taken place in the types of boilers. The marine fire box boiler is the most common type, though the Scotch boiler has replaced it rapidly of late years; 731 boilers of this type are in use to-day, 18 of them having been built earlier than 1870, 97 of them between 1870 and 1880, 392 between 1880 and 1890, and only 224 since 1890. The Scotch type of boiler has one example built earlier than 1870, 8 between that and 1880, 193 between 1880 and 1890 and 348 since 1890, a very rapid increase during the last seven years. The marine water-tube boiler is of more recent date, only one having been built previous to 1880. There are now none of this type on the lakes built between 1880 and 1890, but there are 35 vessels built since 1890 equipped with this type of boiler, and there are several vessels under construction which are to be equipped with this type of boiler, and it is the opinion of many engineers that the water tube boiler is the coming boiler for marine use. It is also interesting to note the gradual increase in pressure in boilers built during these several periods. Of those built earlier than 1870, 100 pounds per square inch is the highest pressure, and there is only one vessel of this period carrying 100 pounds, and only one carrying 90 lbs., most of the boilers built during this period carrying from 40 to 55 lbs. Most of the boilers built during 1870 to 1880 carry either 80 lbs., 90 lbs. or 100 lbs. pressure, although there are a few built during this period carrying a much higher pressure, and one carrying as much as 200 lbs pressure. During the period, 1880 to 1890, 276 boilers carry 100 lbs. pressure or less, and 318 carry more than 100 lbs., but there is only one boiler built during this period carrying as high as 200 lbs., 29 carrying 160 lbs., 39 carrying 150 lbs., and the balance ranging from that down to 100 lbs. pressure. Since 1890 the tendency has been to increase the pressure, only 91 boilers being built during this period carrying as low as 100 lbs., while 517 carry higher than 100 lbs. Of this number 75 carry 120 lbs., 82, 125 lbs.; 45, 150 lbs.; 83, 160 lbs., and from that on up to 300 lbs., there being one boiler carrying this highest pressure, 2 boilers carrying 265 lbs., and 12 carrying 250 lbs. pressure.

On Sept. 13th the Mink W. Hanna & Co.'s supply boat was burned to the water line at her moorings, Port Carling. The cause of the fire is unknown. Loss about $1,200; no insurance.

WATER AND HEAT.

AN ADDRESS TO C. A. S. E., TORONTO NO. 2, BY P. TROWERN, TORONTO.

To-night I wish to draw your attention to a tank of water 12 inches square and 12 inches deep, a cubic foot, 1,728 cubic inches or 62.32 lbs. at the temperature of 39 degrees Fahr., which is at its greatest density, that is the molecules or particles of which the water is composed are smaller than at any other degree of heat, and this degree of water is weighed and measured. We will now watch the process of the water freezing and swelling or expanding, not by heat but by the heat leaving it and the cold taking its place; the thermometer standing at 32 degrees, and yet the ice becomes more solid and swelling above our measure, and the mould would burst if it were not allowed to rise—what natural law has been at work to do this? The heat which left the ice is called latent or hidden heat; the thermometer has not revealed it to us for it still stands at 32 degrees. We will now take it out of the mould, and drop it into water at 32 degrees, and find it will float 10 per cent. above the surface. We will measure the cubic foot of water put into the mould and now become ice and find that it measures 1,904¼ inches instead of 1,728 inches. It has gained 176¼ inches or equal to the space of 6.35 lbs of water, a pound being equal to 27.72 cubic inches, or each cubic inch has increased to 1,102 inches. We will now bring the ice back to water and find that we have not lost much, only by evaporation in the air. What was the cause of the ice getting larger than the water we put in the mould as the heat left it. The air kept the molecules apart and enlarged it and yet the thermometer stood at 32 degrees, the same as the water we put in at first.

I here present to you a sketch of the four different states we find water in and we have to handle it to the best of our ability to give motion to our machinery. In one of these compartments we have ice, in the middle one we have water at 39 degrees, the third has water in a boiling state giving off steam into the fourth space, which should be 1,728 times as large as the pound of water in each compartment, while the cold water swells 10 in every 100 lbs. Not by weight, but by measure, the boiling water will measure 1 in 21 or 5 in nearly 100 lbs. or gallons. We will take a pound of water at 32 degrees, put it in a vessel, and put it in, under it a good steady burning lamp, and watch the thermometer standing in it, and find it rises 10 degrees in one minute, this is our unit to work by. We now remove the vessel and put another vessel over the same lamp with a pound of small lumps of ice with a thermometer in it standing at 32 degrees, although the ice is below that degree, equal to our cubic foot of ice—we watch the thermometer, and find that the lamp is sending its heat into the ice, it begins to melt and the temperature remains at 32 degrees until it is all melted, which has taken 14 minutes, at this time we want to know how much heat has the ice received from the lamp to melt it, or how much heat came out of the water, and before it became water again; 10 degrees in one minute will give 14x10 equals 140, yet the thermometer stands at 32 degrees—this 140 degrees is what is called latent heat in ice. We will now proceed to produce steam and find the latent heat in it; let this vessel with the pound of melted ice, now water at 32 degrees, remain over the lamp burning about the same as before; watch the thermometer, and see how it rises, and in 18 minutes it will rise to the boiling point, 212 degrees; 18 minutes by 10 degrees equals 180, plus 32, equals 212. Without disturbing it we will watch and see how long it will take for the water to evaporate, or boil away into steam. We find it has taken 95 minutes or 5½ times as long to leave the vessel in the shape of steam as it did to rise from 32 to 212 degrees, and yet the temperature of the steam gives no indication of rising above 212 degrees; a large amount of heat must have been given off in the 95 minutes; according to our first unit of 10 degrees in one minute, 18 min. by 10 deg. equals 180 deg., 180 multiplied by 95 and divided by 18 is equal to 950 degrees of heat, which have been hidden away in that one pound of steam to make it rise up into its natural element, and to form the clouds which are so useful to us and to the world at large. Had it not been for this beautiful arrangement we would be burnt, and perhaps everything in this world, because clouds are like veils to screen us from such intense heat, and without heat the two gases which form water would remain together as water.

What are these two gases called? Oxygen, 8 lbs., hydrogen, 1 lb., will form 9 lbs. water pure. Unless a great force or energy has been used by some law in nature the water would not have left the vessel, which we left over the lamp. The atmosphere was pressing on the water and keeping it there with a pressure of nearly 15 pounds per square inch, and as soon as sufficient heat had got into it so as to reach 212 degrees, and to cause it to boil and force these two gases to separate or get farther apart, the water or steam rose and passed into the air by means of the visible and latent heat. If we take a vessel with 5½ lbs. of water at 32 degrees, and put a steam discharging pipe with a pound of water changed into steam at 212 degrees, we will find we have 6½ lbs. of water at 212 degrees. Strange to say you cannot weigh heat, it does not seem to have any weight, and the amount that went with the 1 lb. of steam into the 5½ lbs. of water, which changed the 5½ lbs. of water from 32 to 212 degrees became visible heat, but if you take a pound of water at 212 and mix it with 5½ lbs. of water at 32 degrees, we will have 6½ lbs. water at 60 degrees, which shows the amount of heat stored away in the steam. From these figures it appears that 212-60 equals 152 degrees multiplied by 6½ lbs. equals 988 degrees were hidden in the steam. This large amount of heat cannot be destroyed or annihilated, but it is rendered sensible again when the steam is condensed and brought back again to water. The British unit of heat is the quantity of heat that will raise one lb. of water at 39 degrees (on the level of the sea), up 1 degree, that is to 40 degrees. The mechanical equivalent of this heat is of energy or work to raise 772 lbs. weight one foot high, this we are told is the unit of energy of one degree of heat, and before I close this paper I wish to show how some experimenters went to work to find this energy. They made a water-tight box and fitted a paddle-wheel to it with the shaft of the wheel passing through a stuffing box with a pulley on it. The water was weighed and temperature taken, the motion given to the wheel in the box by a weight on a rope around a drum; by the time the water was raised one degree in the box by the motion of the wheel being kept up by the weight it took 772 lbs. weight. This plan was tried and tested in various ways until they became quite satisfied that their figures were correct. The foot pound term has been introduced to express in a convenient way the lifting of a pound to the height of a foot; this is the quantity of heat necessary to raise the temperature of a pound of water one deg. Fahr. being taken as a standard 772 foot pounds, the mechanical equivalent of heat, or by a pound weight to fall 772 feet against the earth, or it would raise 772 lbs. one foot high. It was tried by one of the men to let drop 2 lbs. of water from a height of 386 feet, and when the water had struck the tub to receive it, it had raised ½ deg., or 1 deg. for 772 lbs. The British unit or foot pound was calculated by an engine, the piston having 500 square inches, velocity 200 feet per minute, 500x200x7 is equal to 700,000 or 21 horse units, 1 lb. per minute, one foot high. Suppose 1 lb. of water be taken up in the air 772 feet by evaporation, and it fall into the tub we put to receive it, by the time it has fallen, it has gained one degree; it gives what we require, natural force; it went up by heat, and came down by potential work, and increased in heat.

ACETYLENE ON RAILWAYS.

Some time ago The Canadian Engineer published an article on the use of acetylene gas on railways, describing some developments in which Canadian engineers were in advance of the rest of the world. The following letter from Lt.-Col. J. H. Western, late R. E., inspecting engineer for Government railways of Egypt to P. W. Resseman, Esq., Pontiac Pacific Junction Railway Co., Ottawa, together with Mr. Resseman's reply, which we append, continues the story of the progress of Canadian ideas abroad:

Lt.-Col. Western, writes:

"I am desired by Major Girouard, R. E., president of the State Railways, Egypt, to inform you that he wishes to introduce the acetylene light on his system, and that he has after due enquiry learned that your railway is practically the only one that uses this light. He will, therefore, be exceedingly obliged if you would favor me for transmission to Cairo with full particulars as to system and method employed, results obtained, and where the necessary apparatus can be secured. He learns from the Bulletin of the International Congress that your system up to a year ago was considered most successful, and absolutely free from danger, and being a system of single coach lighting will be eminently suited to his road. Yours faithfully,

"(Signed.) J. H. WESTERN.

"Broadway Chambers, Westminster, London, S. W.

"August 31st, 1898."

The reply of Mr. Resseman was as follows:

"I beg to acknowledge the receipt of your favor of the 31st ult., and am pleased to give you such information as I have in connection with railway car lighting with acetylene gas.

"We have been using the Holland system on the two roads of which I am general superintendent—the Pontiac Pacific Junction and the Ottawa and Gatineau Railway—for nine months. There is really no comparison between the effectiveness of acetylene gas and coal oil for car lighting, with coal oil at 14c. per gallon, and carbide at 5c. per lb., the cost of acetylene gas lighting for railway use is somewhat cheaper than the same lighting by coal oil. I consider that it is the coming light for railways. We have in Canada a problem to face, however, that would not have to be met in any warm country. Owing to the severe frost in winter we have to place the gas generators inside the car to prevent them from freezing. The disadvantage of this lies in the fact that acetylene gas is most difficult to control, and the slightest leak in the generator causes a disagreeable smell in the car. This we hope to overcome, and have been experimenting with better connections from generator to pipe. The gas has no evil effects on the health of a passenger, but, like garlic, the odor is offensive to most persons.

"I find that an ordinary passenger coach, such as we run here, and previously lighted by 14 coal oil burners, can be brilliantly lighted with five 25-candle power burners, consuming each ½-foot per hour. The carbide supplies 5 cubic feet of gas per pound, making the total cost of the lights 2c. per hour, or for a run of hours 20 to 21c. per pair. Of course, there is incidental waste that we cannot get fully controlled. The gas is lost by the vibration of the car, but on the whole the light is efficient and inexpensive. It is absolutely safe as far as fire or explosions are concerned. The gas is generated in small quantities, confined beneath a 7-inch column of water, and any that may escape is so speedily diffused in the surrounding atmosphere that its explosive nature is at once neutralized. In the event of a car turning over the lights go out immediately, and the gas escapes so quickly that fire cannot affect it. So far we have had no accident from acetylene gas, and I cannot conceive how an accident can occur. Say the coach lighted was a sleeping car, 60 feet in length, regulation width, but with all the windows closed, the plant required to light it would generate enough gas to feed 8 to 10 burners of 25 candle-power each, or a consumption of 4½ to 5 feet of gas per hour. If the passengers were all to sleep solidly for ten hours, and the jets were all open discharging unconsumed gas into the car, in ten hours the ratio would be 50 feet of acetylene gas to 4,320 feet of air, sufficient to make a bad smell in the car that would be driven out in half a minute by the opening of a car door. In Egypt or South Africa, where the generators could be placed on the roof or underneath the car, no difficulty would be apprehended from the acetylene gas smell. A railway equipped so that at certain stations, on the arrival of a train, sufficient generators could be taken off and freshly charged ones coupled on, the light could be made continuous. The whole train could be lighted from the baggage car more conveniently than any other way, but for the cutting out or switching of cars. A small closet would hold the plant and connection be made between the cars with hose cocks and rubber hose. This, of course, we cannot use on our lines here. We have three small generators in each car, placed directly over the top inside of the car, of the toilet room. We have experienced very little trouble other than the escape by improper connection, and we hope to entirely overcome this objection in the very near future by obtaining a suitable connection. Low pressure gas is not affected by heat or cold. There are at present scores of patents being issued every month in Canada and the United States for acetylene gas and lamps, and I have no doubt whatever but that in the early future a generator will be invented for railway car use that will be absolutely gas tight, and with the capacity to generate a week's supply of gas for a car without any danger. In the meantime the express trains on the roads of which I have the superintendency have the honor of being the first on the continent, if not in the world, to be lighted regularly with acetylene gas. The generators cost here $12. The carbide is sold here at $4.50 per 100 lbs. What the cost of piping a car in Cairo is you can judge better than I can. In this city it costs about 8c. per foot for the pipe in place; fixtures extra. Pipe used is ⅜-inch for main, and the ¼-inch for connection. Side lights give us the best results. We are using the ordinary gas fixtures, ¼-inch L cocks, porcelain globes with 5-inch rings. I have every confidence in the future of acetylene gas, and advise every railway man to keep posted on its future development. Yours truly,

"(Signed.) P. W. RESSEMAN,

"Ottawa, Sept. 13, 1898." "General Superintendent."

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trade from Great Britain during August and the eight months ending August, 1897, 1898 :—

	Month of August.		Eight months ending August.	
	1897.	1898.	1897.	1898.
Hardware	£5,876	£2,260	£43,031	£10,550
Cutlery	..	5.098	..	36,404
Pig iron	251	1,027	4,053	8,132
Bar, etc.	796	320	6,595	7,559
Railroad	1,068	..	38,722	23,007
Hoops, sheets, etc	11,159	12,173	42 162	36,642
Galvanized sheets	2,743	7,346	28,201	39,807
Tin plates	7 834	12,774	102 776	98,372
Cast, wrought, etc., iron	2,793	1,779	22,070	20,416
Old (for re-manufacture)	677	..	3,254	3,574
Steel	5,266	2,555	34,803	35,452
Lead	2,933	3,866	13,892	20,3-6
Tin, unwrought	1,232	720	11,411	13,143
Alkali	2,625	3,228	20,274	27,825
Cement	3,365	2,671	11,854	14,993

Industrial Notes.

W. Sterling, brass founder, St. John, N. B., is enlarging his premises.

Galt, Ont., has carried a by-law appropriating $12,000 to building a new town hall.

The Goldie & McCulloch Co., Galt, Ont., will supply the machinery for the new C. P. R. elevator at St. John, N. B.

The Pacific Portland Cement Co., Vancouver, B. C., will, it is said, shortly increase the output of its plant to 100,000 bbls. annually.

Peterborough, Ont., has been supplied by the Wm. Hamton Mnfg. Co., with a stone crusher, which is to be run by electricity.

The Fredericton waterworks have just completed the installation of a large steel boiler of 100 h.p. from the works of E. Leonard & Sons.

Bond & Smith, architects, Toronto, are making alterations and additions to a house on Hayter street, Toronto, which includes heating by hot air.

The offer of the English bondholders to sell the present waterworks to the city of Winnipeg for $275,000 has been rejected by the city council.

The laying of the new 24-inch water main in St. John, N. B., is being rapidly proceeded with under the direction of W. Murdoch, C. E., city engineer.

The McLaughlin Carriage Co., Oshawa, Ont., has ordered a 100-horse power Robb-Armstrong engine from the Robb Engineering Co. Amherst, N. S.

Very satisfactory progress is being made with Mooney Bros'. new pulp mill at Mispick, ten miles from St. John, N.B., as the machinery is now being installed.

James Robson & Sons, Oshawa, Ont., are establishing a large tannery in the Cedar Dale premises formerly occupied by Wm. Chaplin, St. Catharines, as a scythe factory.

The Swansea Forging Company is now delivering to Mann, Foley Bros. and Larson, for use on the Columbia & Western Railway of British Columbia, an order for 500 tons of bolts. This is probably the largest order for bolts ever placed with any Canadian manufacturing firm.

D. Miller, Washago, Ont., intends building a saw mill and stave factory this fall.

E. Hanson Greene, P. L. S., Montreal, is making surveys for the projected waterworks for the village of Sutton, Que.

The McLaughlin Carriage Co., Oshawa, Ont., is building an additional building of brick, 150x50 feet, three stories high.

J. D. Ronald has resumed control of the engine building business which he had until a year ago so long carried on in Brussels, Ont.

London, Ont., finds that the cost of its new hospital is increasing as the building progresses; already there is a $20,000 deficit in sight.

The Robb Engineering Co. is building a 60-h.p. boiler for Wm. Curry & Son, Windsor, N. S., and a 30-h.p. for W. C. Hatfield, Parrsboro, N. S.

The village of Andover, N. B., is installing a system of water supply for fire and domestic purposes. The contract has been let to J. B. Porter for about $8,000.

The contract for the concrete substructure of the new bridge over the Ouse in Asphodel township, Peterborough county, Ont., has been given to Wm. Langford.

Bond & Smith, architects, Toronto, have just started to build a church for the parish of Saint Clement, Toronto. The corner stone will be laid on October 8th.

W. J. Campbell, Boston Mills, Ont., has lately bought the Oshawa, Ont., Roller Mills, and is replacing all the old machinery with new and up-to-date appliances.

A large number of Sterling Hack Saw Blades are being sold by the Aikenhead Hardware Co., Toronto. Samples can be had and prices will be quoted on application to them.

An explosion in the mixing room of one of the Hamilton Powder Co.'s mills at Beloeil, Que., totally destroyed the building, Sept. 16. No lives were lost, nor was any damage done to surrounding buildings.

The foundation stone of a new five-story building to be added to the buildings of George E. Tuckett & Son Co., Ltd., has been laid. The building is to be used exclusively in the working of Canadian-grown tobacco.

We understand that T. H. Watson is retiring from the firm of Leather & Watson, Hamilton, and will devote himself entirely to the interests of the Swansea Forging Company, of which he has been manager for several months past.

The officers of Brantford, No. 4, Canadian Association of Stationary Engineers are: A. Ames, president; T. Pilgrim, vice-president; O. S. Merrill, secretary; C. A. Walker, treasurer; A. McKinnon, doorkeeper; J. Nichol, conductor.

The boiler in a brickyard owned by F. W. Entricken, on the 16th concession of Zorra, Oxford county, Ont., exploded Sept. 7th, and instantly killed a young man named Aikens, 19 years of age. The building was badly damaged, and another workman was slightly injured.

The good roads propaganda carried on by A. W. Campbell, Provincial Road Instructor for Ontario, has had excellent results, and this season streets have been built on the most approved plan in the following towns: Berlin, Chatham, Collingwood, Owen Sound, Brockville, Kemptville, Woodstock, Ingersoll, Stratford, Galt, St. Catharines and Lindsay.

We hear that Samuel Siggins, bicycle rim manufacturer, at Woodstock, is in difficulty, and that his banker has taken possession of his assets, which were mortgaged. He began as a carriage maker in 1888. About six months ago he claimed a surplus of $16,500 over liabilities of $3,500, but his assets consisted largely of real estate and machinery, hence his present trouble.

The closing session of the Ontario Association of Executive Health Officers was held in Ottawa, Sept. 27th, and the officers for the next year were elected as follows: President, Dr. J. J. Cassidy, Toronto; vice-president, Dr. Hutcheson, London; secretary-treasurer, Dr. J. J. Mackenzie, Toronto. Council—Dr. W. F. Vanbuskirk, Stratford; Dr. Fee, Kingston; Dr. Robillard, Ottawa; Dr. Wardlaw, Galt; Dr. Hall, Chatham; Dr. McCrimmon, Palermo; Dr. Sheard, Toronto. Good Roads Committee—Chairman, A. W. Campbell, C. E., Toronto; A. McGill, Ottawa; E. B. Shuttleworth and J. J. Mackenzie, Toronto; Capt. Vanbuskirk, Stratford; Dr. P. H. Bryce.

Peterborough, Ont., will lay 6,000 feet of 12 and 15 inch sewers.

The thriving village of Grande Mere, Que., is to have a waterworks to cost $40,000.

The Waterville, Que., Furniture Co., which was recently burned out, is looking for a bonus and a location.

F. A. Hibbard, C. E., Ottawa, is superintending the building of the new bridge over the Madawaska at Arnprior, Ont.

Bothwell, Ont., will build a firehall, lockup and council chamber as an addition to the town hall to cost about $2,000.

The main drainage by-law carried in Ottawa, Sept. 8th, by a majority of over 250. The amount involved is $425,000.

The W. R. Gardner Tool Co., Sherbrooke, Que., is finishing up what orders are on hand, after which the works will be closed down.

An effort is being made by English capital to control the manufacture of carriage wheels, hubs, spokes and bent wood stuffs in Canada.

The Sackville Machine & Foundry Co.'s shops, Amherst, N. S., are now running under the management of L. G. Holder of St. John.

F. C. Freeman, C. E., has made an estimate of $100,000 for a water supply system for Chatham, Ont., proposing to take the water from Morrison brook.

The waterworks commissioners of Rat Portage, Ont., have taken over the works from Secretran & O'Boyle, the contractors, and will complete the work themselves.

The Coulthard & Scott Co., Limited, Oshawa, Ont., manufacturers of agricultural implements, have this summer had a large two-story brick addition built to their works.

The progressive village of Verdun, Que., is to have a system of sewers and a water supply. McConnell & Marion, civil engineers, Montreal, are getting out the plans, and will superintend the work.

Stratford, Ont., is still undecided as to the method of sewage disposal to adopt. On one hand the town is threatened by the Provincial Board of Health, and on the other by the adjoining municipalities, and so must very soon install a system of some sort.

E. N. Page, G. H. Page, Cohoes, N. Y.; D. H. Friedman, Albany, N. Y.; R. Hersey, J. C. Hodgson, W. W. Near, Montreal, have applied for incorporation as the Page-Hersey Iron and Tube Company, Ltd. The chief place of business is to be St. Henri, Que.; capital, $50,000.

W. W. LaChance, architect, Hamilton, Ont., has prepared plans and specifications for a steel and concrete dam at Stoney Creek. The proposed structure has double retaining walls. Pipe will be laid and connection made with the reservoir formed for fire protection.

It is reported that the Sturgeon Falls, Ont., Pulp Co., has acquired from the Ontario Government the right to take pulp wood along Sturgeon river for 20c. per cord. A further consideration is the agreement by the Pulp Co. to spend at least $1,000,000 on buildings in connection with paper and pulp mills.

The Imperial military authorities at Halifax have completed the purchase of a large piece of water front land at McNab's Island at the entrance of Halifax harbor, and will commence at once the construction of a large fort. It will be one of the largest in the Dominion of Canada, and mounted by the most modern and powerful guns.

The Deseronto Iron Co., Ltd., of which F. B. Gaylord, formerly manager of the Gaylord Iron Co., Detroit, is general manager, is making excellent progress with the works now building in Deseronto. All the charcoal produced by the Standard Chemical Co. will be used in smelting, and the chemical company will very greatly extend its operations.

Among institutions teaching by correspondence are the International Correspondence schools, Scranton, Pa., well organized and well equipped with a large staff of instructors. The schools have met with extraordinary success since their establishment in 1891 in teaching machine design, steam engineering, electricity, architecture, mechanical and architectural drawing, mining, plumbing, heating, and ventilation, chemistry, bridge, railroad, municipal, and hydraulic engineering, sheet-metal pattern drafting, English branches, book-keeping and stenography.

William Lavers, contractor, Montreal, has the contract for the public hall, Westmount, Que. Work will be commenced at once.

On Sept. 23, Stirling, Ont., gave the waterworks by-law for $20,000 a majority of 51. Gravitation will bring water from Somerset Lake, elevated nearly 300 feet and distant two miles.

The building trade in Toronto has had a revival this year after several seasons of depression. In 1896 the building returns showed only $657,168, and last year the business was only $938,619. Up to August 25, 1898, the returns amounted to $1,176,890.

S. C. Skinner, F. J. Skinner, A. Louise Skinner, Gananoque, Ont.; J. F. Chapman, E. Chapman, Deseronto, Ont., have been incorporated as the Skinner Company, Ltd., to manufacture carriage hardware and do a general iron and brass foundry business; capital, $75,000; chief place of business, Gananoque, Ont.

The International Silver Company has been formed under the laws of the State of New Jersey, with a capital stock of $15,000,000 preferred and $15,000,000 common stock. The combination is said to have absorbed the leading manufacturers of silverware on the continent including the Standard Silver Plate Co., Toronto.

Stratford, Ont., has decided to grant the Whyte Packing Company of Mitchell, Ont., exemption from taxation for 20 years and guarantee their 4 per cent. debentures to the amount of $30,000 for 20 years, on condition that they erect a pork-packing and curing factory at a cost of $40,000 to $50,000, and employ 75 to 100 men.

Aemilius Jarvis, architect, Toronto, has returned from New York, and announces that the lease for the site of the large new hotel on King St., east, Toronto, has been signed, and that he has interested New York capital in the venture. The plans have been prepared and the promoters state that the building will be at once gone on with.

Dr. Sheard, medical health officer of Toronto has issued a report on sewage, which is very interesting and quite comprehensive as far as it goes, but the many new ideas brought forward in the past eight years are overlooked. No doubt we shall have a second report from Dr. Sheard bringing his really valuable publication up to date.

The incorporation of the great steel trust, to be known as the Federal Steel Company, has been completed in New Jersey. It is the largest company ever admitted under the laws of New Jersey, its paid up capital being $200,000,000. An incorporation tax of $40,000 was paid to the Secretary of State. The location of the principal office of the company is stated to be in Jersey City.

The Maritime Sulphite Fibre Co., Chatham, N. B., has ordered a 500 h. p. cross compound condensing engine from the Robb Engineering Co., Amherst, N. S., to replace the present 250 h.p. simple engine, and to provide for contemplated enlargements of the plant. The new engine is expected to effect a large saving in fuel over the type now used as well as to give much better speed regulation.

A point of special interest in the export of iron plates from Chicago to Belfast, Ireland, is the fact that Harland & Wolff, ship-builders of Belfast, were boycotted by the steel manufacturers because that firm agreed to the terms of the striking engineers some time ago. As no steel could be secured in Great Britain the firm ordered from America. It remains to be seen whether a trade begun under such favorable circumstances can maintain itself under changed conditions.

W. F. Tasker, business manager of the Don Valley Brick Works, stated recently that the works are the largest and most efficient brick-making plant in America. While all kinds of brick are manufactured at this immense plant, pressed brick, enamelled ware, terra cotta, porous terra cotta, flooring, tiles, in all over 300 patterns and street-paving brick are made. This year they have already made 10,000,000 brick, and are now running night and day to fill orders. The prices range from $6.50 for the ordinary brick up to $400 for some of the finer work. A considerable amount of brick was sold in Toronto, and more has been shipped to points from St. John's, Newfoundland, to Vancouver, B. C. The plant is kept running the year round, and employs on an average 80 men. It is situated on the west side of the river Don, just on the eastern limit of the city, and comprises 1,700 acres. The material is practically inexhaustible. In the plot is a shale bank, from which all the red brick is made, three-fourths of a mile in width, two miles in length and 900 feet deep.

Electric Flashes.

The city of Winnipeg has decided to appoint an official electrician.

Brantford, Ont., had its new electric lighting plant put into operation on the 10th of last month.

A second generator is being put in at the Cataract Power Company's works at Decew's Falls, Ont.

The Maritime Electrical Association held its first annual convention on Sept. 27th and 28th in Halifax, N. S.

The town council of Thorold has decided to postpone the submission of the by-law for the $7,000 lighting plant till January next.

The C. P. R. telegraph copper line was completed Sept. 21st from Montreal to Vancouver. This is the longest telegraph line in the world.

The Vankleek Hill Electric Light Co., Vankleek Hill, Ont., is increasing its lighting capacity by the installation of a 50 k.w. S. K. C. two-phase generator.

Fire broke out simultaneously in Nos. 305, 306 and 310 Peel street, Montreal, one night recently. The fire was started by the burning out of part of a lighting fixture.

Municipal ownership of the electric lighting plant in Pembroke, Ont., is being actively canvassed, and there appears to be a strong probability of its being carried out.

The Montreal Street Railway Co. lost over $200,000 by a fire on Sept. 16th, which destroyed a car shed containing 60 cars and seven sweepers. The insurance very nearly covered the loss.

The Canadian Pacific Railway have purchased from the Royal Electric Co., a 50-light 2,000 candle-power arc dynamo, together with 52 arc lamps, for use in their car shops at Hochelaga.

The Warwick Clothing Manufacturing Company of Warwick, Que., is lighting its works throughout by electricity. The order for the necessary apparatus has been given to the Royal Electric Company.

Wm. Kennedy, jun., C. E., of Montreal, is preparing plans for the hydraulic portion of the proposed scheme for bringing power from Ragged Rapids to that town, a distance of about 12 miles. It is thought the entire enterprise would cost about $70,000.

The Citizens' Electric Light Co., of Smith's Falls, Ont., is increasing the electric lighting plant, and has purchased from the Royal Electric Co., a 1,500 light royal incandescent dynamo, with station apparatus complete. This is to be installed at once.

The carborundum works at Niagara Falls, Ont., are now steadily turning out a product of the highest class. It is the intention of the company to very materially enlarge their premises by the erection of an additional building, about twice the size of the present. It is to be one and two stories high.

A United States company which is going to develop the water power of the Jacques Cartier river for electric light and power purposes for Quebec city in opposition to the Montmorency Company, has acquired the chartered rights as regards Quebec of the Standard Light and Power Company, Montreal. It has a capital of half a million, and its president is Emerson McMillan, of New York.

The Niagara Central Railway has been bought by Haines Bros., New York. The road will be converted into an electric road, and it is said there will be a 40 minute service between St. Catharines and Niagara Falls. The trestle work at Merritton and Thorold will be done away with, and the road run on the ground, the motor cars being able to overcome grades which steam cars could not do. The Grand Trunk at Merritton will be crossed on the level by means of interlocking switches. The plans also include the extension of the road.

Galt, Ont., has carried a by-law to buy out the Galt Gas & Electric Light Company, and operate it as a municipal plant.

William Barber Bros., Georgetown, Ont., recently ordered from the Canadian General Electric Company, a 6 k.w. 500 volt motor.

H. Vick & Sons, Orillia, Ont., recently ordered from the Canadian General Electric Company a 50 light incandescent dynamo.

The Midland Elevator Co., of Midland, Ont., is having placed in its elevator a fifty light T.-H. dynamo, from the works of the Royal Electric Co.

New Westminster, B. C., has ordered from the Canadian General Electric Company a 100 light incandescent dynamo, and a 6 h.p. 500 volt motor.

The Deseronto Iron Company, Deseronto, Ont., has closed a contract with the Canadian General Electric Company for a 200 light dynamo with marble switchboard.

The Bells Asbestos Company, of Thedford Mines, Que., has ordered from the Canadian General Electric Company a 100 light dynamo to be installed at Thedford Mines.

The Provincial Asylum at Fairville, N. B., has placed an order with the Canadian General Electric Company for a 6 k.w. motor, and one 8½ k.w. motor of the Edison bi-polar type.

Boivin, Wilson & Company, Montreal, have recently ordered from the Canadian General Electric Company a 100 light incandescent dynamo for their premises at Berthier, Que.

The Hamilton Electric Light and Power Co., has lately placed in its lighting station one 2,000 light Royal alternator, and one 100 h.p. 250 volt direct-current Royal power generator.

The British Columbia Sugar Refinery Company, Vancouver, B. C., has recently ordered from the Canadian General Electric Company, a 25 k.w. generator of the well-known multipolar type.

The Montreal Cotton Company, Valleyfield, Que., in addition to the very large increased order placed in August, has given a further order to the Canadian General Electric Company for a 150 h.p. induction motor.

The British Columbia Electric Railway, in order to meet the increased traffic over its road, recently placed an order with the Canadian General Electric Company for additional car equipments of the well-known C. G. E. 1,000 type.

The Canadian Electric & Water Power Co., Perth, Ont., is installing a 5-h.p. two-phase S. K. C. motor. This is the third installation within a short time, and shows what can be done with the poly-phase system, for developing a power trade for electric light companies and assisting to make the much desired day load.

The West Kootenay Power and Light Company, which is building a parallel line of wires between Rossland, B. C., and the generating plant at Bonnington Falls, has the right of way cut, and poles on the ground for most of the distance. The right of way has been cut clear of everything for a width of 100 feet, and all the tall trees outside of that area, which, if they fell, would injure the line, have also been cut down. The insulators will be housed so as to keep out the snow in winter. The idea in constructing the second line is so that if one line goes down the other can be used and interruption of the service prevented.

The September number of the Street Railway Journal has been made a souvenir of the Boston convention of the American Street Railway Association, and is a quite unusual publication in size, in typographical appearance, and in the character and quality of its reading matter. Among the special features are: "Street Railway Conditions and Financial Results in Metropolitan Boston," which is devoted to a financial analysis of thirty-one street railway properties in and about the city of Boston. These are suburban and interurban in character, and a comparison of their financial characteristics is of interest to street railway capitalists. The Boston Subway is described in considerable detail, the latest plans of the subway and subway stations as finally carried into effect. Proposed New Electric Elevated Railway in Boston is a brief article on the proposed construction. There are also several special contributed articles in which many will be interested, together with descriptions of many new improvements in electric railroading.

Munderloh & Co., Montreal, recently ordered from the Canadian General Electric Company a 12 k. w. incandescent dynamo.

J. H. Head, Hagarsville, Ont., has recently ordered from the Canadian General Electric Company, a very compact lighting plant. The generator will have a capacity of 50 lights.

Tromanhauser Bros., Goderich, Ont, have placed an order with the Canadian General Electric Company for a 200 light incandescent dynamo, which they propose to install to light their elevator buildings.

The Canadian Pacific Railway smelter at Trail, B. C., recently placed an order with the Canadian General Electric Co. for a 50 light 2,000 c.p. brush arc dynamo, together with the necessary lamps. These are to be used at the smelting works at Trail.

John Ballantine & Son, Preston, Ont., have given a contract to the Canadian General Electric Company for a lighting plant, including a 100 light dynamo with instruments. The order includes the wiring up of their premises for use of incandescent electric lighting.

The Linde British Refrigeration Company, Montreal, has recently ordered from the Canadian General Electric Company a 15-h.p. three-phase induction motor. The power will be supplied to this induction motor from the circuits of the Lachine Rapids Hydraulic & Land Company.

The Peoples' Electric Company, Windsor, Ont., owing to the very large and satisfactory increase in its lighting business has recently placed an order with the Canadian General Electric Company to supply it with a 2,000 light iron-clad ventilated armature type single-phase alternator.

The city engineer of Toronto has refused to draw up specifications for a 6,000 h.p. municipal power plant as ordered by the council, and has recommended that $1,000 be appropriated to secure the services of an expert consulting electrical engineer, who would draw the specifications.

The Royal Electric Company has sent to its friends a very fine photo, 14x21 inches, of the group taken on the occasion of the visit of the Canadian Electrical Association to the power-house at Chambly, Que. The picture is taken in front of the power-house, and makes a very interesting souvenir.

The War Eagle Consolidated Gold Mining Company, Rossland, B. C., has ordered from the Canadian General Electric Company, two 2-h.p. induction motors, and one 10-h.p. induction motor. The power to operate these induction motors is to be furnished by the West Kootenay Power & Light Company.

The Peterborough and Ashburnham, Ont., street railway was sold by the sheriff, Sept. 12th, under an execution for fifty odd thousand dollars. The purchaser was Arthur Stevenson, and the price paid $20,000. It is understood that Mr. Stevenson acted for some of the largest stockholders in the present directorate. The sale will not affect the operation of the road at present, as it will be run as heretofore until some further arrangements are made.

The T. Eaton Company, Ltd., Toronto, has given an order to the Canadian General Electric Company for the installation of a 130 k.w. direct connected generator, with marble switchboard, containing the necessary instruments for the generator. When this generator is installed the T. Eaton Co. will have three 130 k.w. generators, and two 50 k.w. generators of the Canadian General Electric Company's well known direct connected direct current lighting generators.

E. S. Jenison is promoting a scheme of power development on the Kaministiquia river to supply Port Arthur, Ont., and Fort William. The proposal is to build a water-power canal from above the Ecarte Falls on the Kaministiquia river to the boundary of Port Arthur, where a storage reservoir will be built. The water will be delivered with 300 feet head. The intention is that the towns of Port Arthur and Fort William shall get their water supply from this source, which will likewise give them a fire pressure by gravitation. Both towns are to be supplied with water sufficient to generate electricity to supply the Port Arthur electric railway, and the lighting plants. The company is to have the right to furnish water-power, compressed air, and electric power to the manufacturing institutions in the two towns.

The Canadian Oiled Clothing Company, Toronto, has recently found it necessary to increase its factory premises, and has removed from Port Hope, Ont., to Toronto. An order has been given to the Canadian General Electric Company for the installation of a 100 light incandescent lighting dynamo.

The Hamilton Blast Furnace Company, Hamilton, Ont., has given a contract to the Canadian General Electric Company for the installation of a 150 light incandescent dynamo with switchboard and the necessary instruments, and is also having the factory wired up for the use of incandescent lights and long burning direct-current arc lamps.

An evidence of the improvement in business conditions attending the manufacturing and other interests throughout Canada is markedly indicated by the large number of isolated electric lighting plants being installed this season and the many increases in the generating capacity for both lighting and power work, which are being made in central station plants.

D. A. Gordon, Wallaceburg, Ont., who has secured a franchise for the installation of an incandescent electric lighting plant in the town of Tweed, Ont., has recently given an order to the Canadian General Electric Company for one of their 500 light single phase alternators. The order also includes the necessary material for the erection of a complete lighting plant.

Jay P. Graves, manager of the Big Three Gold Mine Company, Rossland, B. C., has just placed an order with the Canadian General Electric Company for a 75 k.w. synchronous motor. This motor is to be used in the development of the mine at Rossland, and the current for its operation will be derived from the power circuits of the West Kootenay Power & Light Company.

Judge Tellier has recently rendered judgment in the case of Mrs. Dominica Delvero against the Montreal Park and Island Railway Company. The plaintiff, who resides in Italy, claimed, in her name, and in the name of her five children, $5,000 damages on account of the death of her husband, who was killed while working in the service of the defendant company. Delvero was employed with a gang of other men in the construction of one of the company's lines. A platform car was used to carry rails from one point to another, and the men were in the habit, although against the rules, of getting on this car and allowing it to slide down the grade, when going for rails. On the day when the accident occurred, a big branch had been cut down from a tree, and was lying across the track, and as the men coming down on the platform car could not prevent a collision, having no brake, they jumped off. In doing so, Delvero sustained injuries from which he died two days after. His widow then took out the present action. In rendering judgment, the Court held that it had not been proved that the deceased had been made aware of the rule forbidding the men to get on the platform car. Moreover, this order seemed to be pretty much a dead letter, and the use of the car for the convenience of the men themselves seemed to have been tolerated. Under these circumstances the company must be held responsible for the accident. In the absence of sufficient proof, the Court assessed the damage at $1,000 and rendered judgment in favor of the plaintiff for that amount.

Mining Matters.

The Canadian Gold Fields Co., Deloro, Ont., has ordered a 50-h.p. tandem compound engine from the Robb Engineering Co., Amherst, N. S.

Notwithstanding the closing down of the mines on Labor Day the ore shipments from Rossland, B. C., for the week were very heavy— Le Roi, 2,277 tons, War Eagle, 1,233; Iron Mask, 66.

H. H. Eames' process for treating arsenical ores was tested at Actinolite, Ont. The experiment is said to have proved a success and the results are so satisfactory that operations will be immediately commenced on an extensive scale.

A. E. Carpenter, Hamilton, and Jno. Patterson, are developing a mine of magnetic iron ore on the Kingston and Pembroke. W. G. Walton, Hamilton, Ont., has also discovered a vein of magnetic ore. Both have been tested and favorably reported on by the experts of the Hamilton, Ont., Blast Furnace Co.

Rich finds of gold are reported from the Hootalinqua River, Yukon Territory.

There is considerable excitement in British Columbia over a find of placer gravel on Rover Creek near Slocan Junction. Gravel is said to have been found giving 75 cents to the pan, and during the first day or two after the discovery no less than eleven claims were located.

Andrew Bell, C. E., Almonte, Ont., has prospectors at work in the iron mining regions of Darling, Lanark county, Ont., and is preparing a map, showing the sections which are of value, with the ultimate object of shipping the ore to the new smelting works at Deseronto, Ont.

The recent discoveries of hematite in the Madoc district, Hastings county, Ontario, have led to a proposal to re-open the G. T. R. branch line from Madoc to the C. O. R., which has been disused since the Wallbridge mine, in the neighborhood of the recently discovered mines, became exhausted.

Zinc is advancing from $30 to $33 per ton, coming within $1 of the highest price on record, which was reached a month ago. The present advance is attributed to the increasing demands for zinc ore. New mines are being opened all over the districts and many old abandoned mines are again being worked.

The Bruce Mines, Ont., the great copper property out of which $1,000,000 worth of metal was formerly taken, has been purchased and paid for by a syndicate formed by Lord Douglas of Hawick. The work has been pronounced by experts to be sufficient to demonstrate the fact that very large and rich copper veins run from Bruce Mines in a northwesterly direction towards Lake Desbarats.

At a meeting of the Board of the Iron Miners' Association of Ontario, held recently, R. C. Clute, Q. C., was elected president in the place of Hon. Senator McLaren, who could no longer continue to perform the duties of the office. Mr. Clute is interested in one of the few Ontario mines that have done an export trade, but it is closed at present on account of lack of transportation facilities. The secretary of the association reports that almost daily enquiries are being received from Great Britain as to the prospects of iron mining here and our ability to supply the British market. He also reports that mining properties are in more active demand and several fine properties have recently been acquired by members of the association.

The new Atlin gold fields in British Columbia are said to be more extensive than those of the Klondyke. No creeks as rich as El Dorado have been found, but on six or seven creeks claims are paying $20 per day per man above expenses. The results are being obtained above bedrock, which has been reached only in few instances. Since July mining has been in progress on Pine and Spruce creeks, emptying into Lake Atlin. Within the last few weeks rich discoveries have been made on Boulde or Musket Wright, Birch, Moose and Surething creeks, and on large glacial moraines. Near Pine Creek wonderfully rich bench claims are being opened on moraines, which are the piles of gravel and sand brought down by the glaciers from the higher ground.

Though it might be very unwise to place too implicit reliance upon the reported extent and value of the recent gold find in Queen Charlotte Islands, of British Columbia, yet it is well to recall the fact that the first authenticated discovery of gold within the limit of what is now the Province of British Columbia occurred at Mitchell's, or Gold Harbor, on the west coast of these islands, in 1857. According to Dr. Dawson, at least $20,000 worth of gold was obtained at this point, but the amount has been estimated as high as $75,000. The same authority states that no paying gold placers have been discovered on the islands, but the precious metal has been found not merely in the nugget form, but existing in numerous quartz veins of small extent in various localities. It is also present in fine scales in deposits of magnetic iron ore, in the neighborhood of Cape Fife. As a matter of fact, the mineral producing possibilities of these islands cannot be regarded as satisfactorily ascertained.

A tunnel 3,000 feet long is to be driven on the Columbia & Western railway, now a part of the Canadian Pacific system, about three miles from Brooklyn, B. C., and at an altitude of about 2,000 feet above the Columbia river. Its dimensions are 3,000 feet long, 21 feet high and 16 feet in width, and it will require the excavation of about 28,000 cubic yards or 85,000 tons of syenite, which is the prevailing rock of the mountain. It will take about ten months to drive this tunnel, although the other portion of the line will be completed before that time. During the driving of the tunnel, trains will be transported over the divide by means of a series of ten switchbacks, which will be abandoned when the tunnel is completed. McLean Bros. have the contract under Mann, Foley & Larson, and have purchased a large Ingersoll-Sergeant plant from the James Cooper Manufacturing company of Montreal, consisting of two large compressors, 14 air drills, boilers, pipe line, etc., the cost of which when installed will be about $22,000. The tunnel will be driven from both ends and the driving should progress at the rate of from 8 to 10 feet per day on each end.

The Regina mine in the Rainy River district, which is owned by a close English corporation of which Sir Henry Wilkinson is the head, is the deepest mine in Ontario, the main shaft being down 434 feet. In addition to the shaft, says The Rat Portage Miner, the mine has over 2,000 feet of drifting, the longest drift being 400 feet. On the seventh level drifts are being run on each side of the shaft, and at present both heads are in fair ore. The bottom of the shaft was in good ore, when sinking was discontinued for the present, as ground enough is now opened to keep the mill running for a long time. A drift is being run under the lake on the sixth north level with good success. Stoping is now being done on the upper levels, and last week some phenomenally rich stuff was struck. The company have recently put in a battery of seven Tremain stamp mills, equal to about 35 stamps of the gravity pattern, which supplanted the old 10-stamp mill. The new plant is said to be giving good satisfaction, and is treating from 1,800 to 2,000 tons of ore a month. The production of gold bullion, while not stated, is said to be entirely satisfactory to the owners, and the mine is on a paying basis. A considerable percentage of the ore is of the concentrating quality, which condition has necessitated the putting in of concentrating machinery, consisting of two 3 compound Hartz gigs, which do very good work. The mine is also equipped with a 16-drill Ingersoll-Sergeant compound condensing compressor plant. The shaft is simply a development shaft, and the company now think that in a very short time they will sink a new vertical and permanent shaft, which will mean the expenditure of many thousand dollars, but the output of the mine warrants the undertaking.

Brief, but Interesting.

A new and highly important invention was tested at the German manoeuvres this autumn. It was in the shape of a Greek Phoenician fire, invented by a Berlin engineer. It ignites on contact with the air or water and cannot be quenched by either water or other things. It burns with a brilliant flame, and it can be sunk under water or under ground and when brought to the surface instantly bursts into flame at any desired point. It was tested during the night, off the island of Heligoland and off Kiel and proved most efficient in detecting the presence of the enemy.

At the annual conference of the Association of Municipal and County Engineers in Edinburgh, a short time ago, Donald Cameron, city surveyor of Exeter, Eng., the inventor of the septic tank system of sewage treatment, read a paper, in which he said that one of the most notable points observed in the Exeter tank had been the hitherto unrecognized energy stored in sewage, as evidenced by the production of marsh gas. The works and public paths adjoining Exeter had been lit with the gas. He had not had more than ten such lights burning at one time, but it was apparent, even under the conditions of leakage existing, that more than twice this number could be kept constantly alight, and this estimate was made during the cold, wet weather of last winter. The gas was innocuous, and could only be detected ordinarily by applying a light.

It now appears that some bodies, even without special stimulation, are capable of giving out rays closely allied, if not in some cases identical, with the Roentgen. Uranium and thorium compounds are of this character, and it would almost seem from the important researches of Dr. Russell that this ray-emitting power may be a general property of matter, for he has shown that nearly every substance is capable of affecting the photographic plate if exposed in darkness for sufficient time. No other source for Roentgen rays but the Crookes tube has yet been discovered, but rays of kindred sorts are recognized. The Becquerel rays, emitted by uranium and its compounds, have now found their companions in rays—discovered almost simultaneously by Curie and Schmidt—emitted by thorium and its compounds. The thorium rays affect photographic plates through screens of paper or aluminum, and are absorbed by metals and other dense bodies. They ionise the air, making it an electrical conductor; and they can be refracted and probably reflected, at least diffusively. Unlike uranium rays, they are not polarized by transmission through tourmaline, therefore resembling in this respect the Roentgen rays. Quite recently M. and Mme. Curie have announced a discovery which, if confirmed, cannot fail to assist the investigation of this obscure branch of physics. They have brought to notice a new constituent of the uranium mineral pitch-blende which in a 400-fold degree possesses uranium's mysterious power of emitting a form of energy capable of impressing a photographic plate and of discharging electricity by rendering air a conductor. It also appears that the radiant activity of the new body, to which the discoverers have given the name of Polonium, needs neither the excitation of light nor the stimulus of electricity; like uranium, it draws its energy from some constantly regenerating and hitherto unsuspected store, exhaustless in amount. It has long been to me a haunting problem how to reconcile this apparently boundless outpour of energy with accepted canons. But as Dr. Johnstone Stoney reminds me, the resources of molecular movements are far from exhausted. There are many stores of energy in nature that may be drawn on by properly constituted bodies without very obvious cause. Some time since I drew attention to the enormous amount of locked-up energy in the ether; nearer our experimental grasp are the motions of the atoms and molecules, and it is not difficult mentally so to modify Maxwell's demons as to reduce them to the level of an inflexible law and thus bring them within the ken of the philosopher in search of a new tool.

The "gold from sea water" enterprise of the Electrolytic Marine Salts Co., of North Lubec, Me., has suspended operations and the "inventor" of the process and manager of the company, "Rev." P. F. Jernegan, has absconded, it is reported in The Engineering News, after having received $338,000 of the "profits," which were derived not from sea water but from the stockholders. He sailed for Europe under an assumed name after having converted about $100,000 cash into government bonds in New York city, and his arrival at Havre on his way to Paris has been reported by cable. Steps have been taken to have him shadowed by detectives in France until papers can be sent charging him with embezzlement, on which his extradition may be secured. It is said that about $300,000 out of the $10,000,000 capital stock of the company was subscribed for in Newburyport, Mass., by bank directors and leading business men, who were led to subscribe through their confidence in the judgment of A. P. Sawyer, a local capitalist, and W. R. Usher, a large shoe manufacturer of that city, both of whom were directors in the company. One report says that $2,400,000 of the stock has been sold at par, that 45 per cent. of the money received went to the promoters, 20 per cent. to the "financial agents," and the remaining 35 per cent. into working capital, some of which was expended in the construction of the works at North Lubec, upon which 600 men have been engaged. The New York Herald of July 31 gives an interesting account of the preliminary experiments of the "inventor," near Providence, R. I., by which he obtained his first contributions of capital. It appears that a small shed was built at the extremity of a long slender wharf projecting from the shore of Narragansett Bay, and through a hole in the floor there was lowered by means of a windlass a large box containing a pan of mercury. An electric battery supplied by the "inventor" was applied during a whole night in the presence of some capitalists from Middletown, Conn., who had brought with them the mercury. The next morning the mercury was lifted from the water and given to a chemist who assayed it, and found in it $4.50 of gold, and thereupon the capitalists, much pleased, paid the first instalment on their investment. The deception in the experiment, according to the detective, consisted in a diver's proceeding under water during the night to the box, pouring out the mercury, and substituting for it another lot of mercury containing gold. Upon this basis was floated the $10,000,000 company. Its success in obtaining gold at North Lubec was attested by its sending frequently to the New York Assay office "gold bricks" containing each about $2,000 of gold, and the exhibition of similar bricks at the company's office in Boston. The "gold from sea-water" scheme thus appears to have been one of the most gigantic swindles of recent years. It was similar in many respects to the Electric Sugar Refining swindle in New York city in 1884, by which many prominent business men, including even sugar refiners, were victimized. One of the operators in that scheme was convicted and sentenced to nine and a half years' imprisonment. It is to be hoped that a like fate will meet the Rev. Jernegan and his accomplices.

Railway Matters.

Truro, N.S., has voted $30,000 to the Midland Railway Co., on condition that the road enter Truro by way of Clifton instead of joining the C. P. R. at Brookfield,

The surveyors engaged in locating the Southeastern Railway have reached the War Road harbor in Minnesota, and expect to be at Rainy River within five weeks.

The contract for the superstructure which is required to permit the removal of the obstruction at the Sault Ste. Marie canal has been awarded to the Dominion Bridge Company.

Emile and Jean Stehelin, proprietors of the Weymouth and New France Railway, Digby county, have ordered another locomotive from the Robb Eng. Co., Amherst, N. S., for their pole railway.

Arthur White, assistant general freight agent of the G. T. R., has recently inspected the disused Madoc and Eldorado branch of the Grand Trunk, and states that the company will not reopen it to aid the development of iron mines unless they can obtain Government assistance. The line has been closed for years, and will require a good deal of reconstruction.

The C. P. R. is building at Calgary, N. W. T., the following buildings: An engine house to hold twelve locomotives, machine shop, car shop, blacksmith shop, stores building, coal pockets, ash pits and turntable. All the buildings will be of Calgary sandstone. The machine shop and car shop will be 200 feet by 66 feet, the blacksmith shop 60x66 feet, and stores building 24x30 feet.

The Grand Trunk Railway Company has recently added to its new equipment four baggage cars, 60 feet in length, and a large number of new refrigerator cars on the well-known Wicke's patents for refrigerator cars. The cars are about thirty-five feet long, and thirteen feet high, with a carrying capacity of 60,000 lbs. each. They are also equipped with automatic draw-bars, and Westinghouse air brakes, and designed to run at a high rate of speed. The Wells and French Car Company, of Chicago, have just commenced the delivery to the Grand Trunk Railway of 500 new thirty-ton box cars, of the standard Grand Trunk design and finish.

The Kootenay Railway & Navigation Company is being floated in England, and has been formed to consolidate and extend the railway and steamboat service in British Columbia controlled by J. J. Hill. This company will acquire the Kaslo & Slocan railway and the steamers of the International Navigation & Trading Company, which at present run between Kaslo and Nelson and connect with the Spokane Falls & Northern Railway. A new line is to be built 53 miles long from the southern end of Kootenay Lake to meet the Great Northern at Bonner's Ferry, and the Northern Pacific at Sandpoint, and in future, it is said, the line of steamers will run from Kaslo to the southern end of Kootenay lake instead of to Nelson.

There have been some doubts as to whether the deepening of the St. Lawrence canals to 14 feet can be completed by the opening of navigation next year. In the mind of the canal experts here those doubts have now been set at rest. Collingwood Schreiber, the chief engineer of canals, returned recently from an inspection of the works, in company with Walter Shanly, C. E. The latter has been very skeptical up to date as to the early completion of the work. However, both these gentlemen state that they are satisfied that, if the present rate of progress is maintained during all the available time in the interim, the canals will be completed to a uniform depth of 14 feet by the opening of navigation next season. The only possibility of failure arises from the fact that the contractors may relax their energy.

The convention of railroad trackmen have elected the following officers: James Logan, Ottawa, president; J. Hogan, Ottawa, first vice-president; J. W. Trickey, Sudbury, second vice-president; H. F. McKinney, Hintonburg, recording secretary; J. Hogan, Ottawa, treasurer; W. Powell, Moncton, chaplain; A. Hawkins, Fletcher, guide; C. Noyes, Peterboro, sentinel.

The Grand Trunk Railway is said to have secured a contract for the transportation of a hundred thousand tons of steel plates from the Illinois Steel Company, Chicago. These plates are to be shipped to Belfast, Ireland, and are being brought to Midland, Ont., handed over to the Grand Trunk, and shipped to Montreal for export to Belfast.

Marine News.

H. McLennan, J. Crathern, G. Hyde, A. Kingman, H. E. Murray, Montreal, and A. Buntin, Toronto, have been incorporated as a steamship company doing business as the Beaver line; capital, $250,000.

J. T. Hamilton, H. M. Hart, G. Musgrave, C. W. Outhit, R. T. Braine, T. Dixon, W. J. Butler, F. J. Phelan, L. Hart, W. N. Wickwire, J. A. Johnson, Halifax, N. S., have been incorporated as the Briardene Steamship Company, Ltd.; capital $60,000.

The special committee appointed by the Toronto City Council to report on the best means of providing communication between the city and the Island other than the present ferry service has decided on a chain ferry at the Queen's Wharf to cost $8,000.

At a meeting of the board of directors of the Richelieu & Ontario Navigation Co., held in Montreal, Sept. 7th, contracts for new boilers for several vessels of the fleet were awarded, and it was decided to build three additional steamers for next summer's business, two for the Montreal and Quebec route, to be built in Montreal, and a third boat for the western trade.

The last link between the Crow's Nest Pass Railway and Nelson, B. C., will be completed when the C. P. R. places upon the Kootenay lakes service a vessel specially adapted for the traffic. It will be of the enlarged tug type and very powerful. The length is 128 feet, 25 foot beam, and it is designed to draw 10¾ feet of water. The engines are compound jet condensing, and the cylinders 18 and 32 inches, with a 22-inch stroke. The reason for the exceptional power is that the new craft is to haul the car barges which will ply between Kushonook on the completion of the C. N. P. R. to that point and river points with terminal connections.

M. R. Davis, Kingston, Ont., will superintend the building of a new boat for Capt. D. Noonan. It will be a twin screw steamer, costing about $20,000, having thirty staterooms, and designed to carry about 300 passengers. It will be built at Westport, Ont., and is intended for service on the Rideau canal.

Midland, Ont., is doing a vastly improved business this season and is rapidly coming to the front as a lake port. The depth of water in the harbor admits vessels of deeper draught than can enter most lake ports, and early in the season the Superior City arrived at Midland from Chicago with a cargo of 266,550 bushels of corn. This enormous cargo was delivered in Montreal in 48 hours.

Work will soon be over for the season on the survey which is in progress for a canal line from Hungry Bay, on the St. Lawrence, to Lake Champlain. The United States Congress authorized a commission to report on the practicability of improved waterways between the Western States and the seaboard, which, after making a preliminary report, was authorized to go to the expense of surveys of every practicable route sufficiently full to base estimates of cost upon. This summer surveys have been in progress for a canal on the United States side between Lakes Erie and Ontario and between Lake Ontario and the Hudson river, and between Lake St. Francis and Lake Champlain.

The Government dredge Cape Breton is at work in the harbor of St. John, N. B. The construction of the deep water terminus for the I. C. R. is being pushed.

The Grand Trunk Railway Co. has a contract with the Leyland Line for a tri-weekly steamship service during the coming winter between Portland and Liverpool. Five of this company's vessels, which are now plying between Liverpool and New York, will be transferred to the Portland route. These vessels will replace the ships of the Dominion Line, which, last year gave the service between Liverpool and Portland. The new arrangements will come in force only next year, and, in the meantime, the Allan and Leyland lines will work together on that service. It is also reported that the Leyland line next summer will make an effort to retain the Canadian business secured during the winter months by running into Montreal instead of New York.

Personal.

W. A. Clement, C. E., the Toronto city roadway engineer, is very seriously ill with typhoid fever.

Wm. Reid was accidentally killed by the fly wheel at the Metropolitan Rolling Mills, Montreal, last month.

F. R. F. Brown has opened an office at 22 Street Railway Chambers, Montreal, as a consulting mechanical engineer.

R. Barrow, son of the Hamilton, Ont., city engineer, has entered the engineering course at the School of Practical Science, Toronto.

James McKenna, a delegate to the firemen's convention in Toronto, was killed at Morrisburg, Sept. 10th, while attempting to board a moving train.

S. Aikens, fireman, was on Sept. 14th instantly killed by the explosion of a boiler in Frank Entrichen's brickyard on the 5th line of Zorra, Oxford county, Ontario.

James McArthur, land surveyor, Aylmer, Que., who was nearly boiled to death while taking a bath at Eastman's Springs, died a few days later. He was 78 years old.

N. Bruchesi, an engine driver on the Grand Trunk Railway, died suddenly in Montreal a short time ago. Mr. Bruchesi was the driver on the first engine that passed over the Canada Atlantic Railway.

Thos. Graham, proprietor of the Banner File works, Almonte, Ont., died at his home there. He was born in Ecclesfield, England, in 1834, and was twice married, being the father of twenty-one children. Mr. Graham was at one time at the head of a very large hand cutting file works in Toronto.

Dr. John Hopkinson, an English electrical engineer, and his son and two daughters have been killed, while ascending the Dents de Vaulion, in the Canton of Vallais, Switzerland. A summary of Dr. Hopkinson's report on the transmission of electric power from Niagara to Toronto was published in The Canadian Engineer some months ago.

C. H. Sutherland, a well-known draughtsman in the motive power department of the Grand Trunk Railway, died suddenly at his residence, Montreal, recently. He had not been in the best of health for some days, but no serious results were anticipated. Heart disease is supposed to have been the cause of death.

W. C. Clark, an engineer in the employ of the C. P. R., was found dead on the floor of his room at the village of Cedars, near Montreal, last month. He was partially dressed, and is supposed to have died while preparing for bed. He was 27 years of age. An inquest was held and a verdict returned of death from indigestion and cerebral congestion.

James Brown, C. E., died in Amherst, N. S., a short time ago, aged 57 years. Deceased was born in Aberdeen, Scotland, and came to this country in 1876. He was a practical engineer of great ability, and besides being for a term manager of the Londonderry mines, held responsible positions on the Intercolonial and Canadian Pacific railways, at Joggins Mines, Springhill, and Glace Bay. Mrs. Brown, who was Miss Sybella Gilbert, sister of Lord Belhaven, and one daughter, May, survive him.

Ed. Cooper, late manager and part proprietor of the Cooper Machine Co., Toronto, manufacturers of the Imperial Gas Engine, has taken a position as traveling representative of the Goldie & McCulloch Co., Galt, Ont.

While attempting to stop the fly wheel of a wood sawing machine, with a piece of wood, Peter Grice, Victoria, B. C., was instantly killed, death being caused by the fly wheel breaking, pieces of which penetrated the body, tearing out the heart and liver, both of which were afterwards picked up by the police.

The department of mathematics in McGill University will be strengthened by H. M. Tory's transference from the Physics Department, in which he has hitherto done part of his work; and he will be more at liberty, in the future, to undertake lecture and tutorial work in the first years of the mathematical curriculum. Mr. Tory's work in the physical laboratory will be taken over by R. O. King.

At the annual general meeting of the Great Northwestern Telegraph Company, Toronto, the following officers were elected: H. P. Dwight, president and general manager; Adam Brown, of Hamilton, vice-president; H. N. Baird, James Hedley A. S. Irving, W. C. Matthews, of Toronto, Richard Fuller, of Hamilton, Hon. William McDougall, C. B., of Ottawa, and Charles A. Tinker, of New York, directors; George D. Perry was reappointed secretary and auditor, and Arthur Cox, treasurer. The statement of the year's business showed a considerable improvement over the previous year, and the opinion was expressed that with the new connections and extensions of the company they might reasonably look for a still further improvement during the coming year.

Thomas Fuller, late chief architect of the Department of Public Works, died at his residence in Ottawa, Sept. 28th, aged 76. Mr. Fuller was born in Bath, Eng., and came to Canada in 1857. In 1859 in competition for parliament and departmental buildings, Ottawa, his design for the parliament building was adopted, and he was awarded second prize for his designs for departmental buildings, which included a residence for the Governor-General. Mr. Fuller superintended the erection of the parliament buildings. In 1867 he was the successful competitor for a design for the new capitol building for the State of New York at Albany, and removed to that city, where he superintended the erection of the building. In 1881 he returned to Canada, and was appointed chief architect of the Public Works Department, a position he held until about a year ago, when he was superannuated, but retained an advisory position in the department. His health has been failing for some time. Mr. Fuller was well-known throughout the whole of Canada, and has designed the greater number of all the public buildings erected in the last fifteen years.

Dr. James Wallace Walker, the new professor of organic chemistry at McGill University, was educated at the University of St. Andrews, Scotland, and graduated there as Master of Arts in 1889. After a short time spent in teaching mathematics at the Madras College, St. Andrews, he was appointed lecture assistant in chemistry at the university and afterwards engaged in original research in organic chemistry. In 1892 he entered the University of Leipsic, and was shortly afterwards elected to an 1851 Exhibition Scholarship. In Leipsic he studied chemistry in the laboratories of Professors Wislicenus and Ostwald and was awarded in 1896 the degree of Ph.D., with highest honors. On rturning to England Dr. Walker worked for a short time in the laboratory of Professor Armstrong at the Central Technical College, in London, but soon afterwards, in 1896, was appointed lecturer in organic chemistry under Professor Ramsay, in University College, London, and was last year also appointed examiner in chemistry for the Arts, Science and Medical degrees at the University of St. Andrews. Dr. Walker has published the results of his researches in a number of papers. He is a clear and lucid lecturer and he has proved himself to be an attractive teacher, both with elementary and advanced students.

The Board of Governors of McGill University has appointed Professor R. B. Owens, E.E., of the University of the State of Nebraska, to the W. C. McDonald chair of electric engineering at McGill University, lately held by Professor Carus Wilson. Professor Owens is a native of Maryland, and was educated at Johns Hopkins University, Baltimore, obtaining a high standing in mathematics and physics. Proceeding from Johns Hopkins University to Columbia University, he there obtained in 1891 the post-graduate degree of E.E. In the intervals of his college course the young student acquired a fund of practical knowledge with several well-known electrical companies. Shortly after receiving his degree Mr. Owens was appointed assistant professor of electrical engineering in the University of Nebraska, and in 1894 he was made professor. In the meantime he served as one of the judges of electrical exhibits at the World's Fair. Professor Owens has recently been elected to a Tyndall fellowship by Columbia University, and was director of the Bureaus of Electricity and Machinery at the Trans-Mississippi Exposition at Omaha. He is a member of the Western Society of Engineers, the American Society of Mechanical Engineers, and the Council of the Society for the Promotion of Engineering Education, and vice-president of the American Institute of electrical engineers. He has contributed important articles to engineering societies and to the electrical press on the subject of Electricity and of Technical Education.

Prof. Ernest Rutherford, who has been appointed to the W. C. McDonald chair of physics in McGill University, recently vacated by Prof. Callendar, was a student at Canterbury College, Christchurch, New Zealand, for five years, obtaining the degree of B.A. in the University of New Zealand, in 1892; the degree of M. A. by examination in 1893, with double first-class honors in mathematics and physical science; and the degree of B.Sc. in 1894. During 1894 and 1895 he was engaged in research work, and in the latter year was awarded an 1851 Exhibition Science Scholarship to enable him to continue his researches in England. Proceeding to Cambridge, he has carried on investigations in experimental physics in the Cavendish Laboratory for the past three years under the direction of Prof. J. J. Thomson, and in June, 1897, was awarded the degree of B.A., and in the following December the Coutts-Trotter Studentship, in recognition of his researches. Prof. Rutherford's experience in teaching has been gained in New Zealand and by acting as demonstrator of physics in the Cavendish Laboratory. In addition to a research upon Uranium and Thorium Radiation, which has occupied his attention during the past year, Prof. Rutherford has completed several important researches. Among them may be mentioned: An investigation on the use of a magnetic detector for the investigation of electrical waves; with this detector he was able to send signals by means of electric waves, and without wires, across about ¾ of a mile of the mostly densely-populated part of Cambridge. This was done nearly three years ago, and before the recent attempts at wireless telegraphy. A series of papers in The Philosophical Magazine, on the electric properties of gases under the influence of Roentgen rays, Uranium rays, and ultra-violet light. These papers are characterized by Prof. Thomson as being distinguished by the importance of the results obtained by the ingenuity displayed in the design of the apparatus, and by the grasp of the physical principles shown in the interpretation of the results. Prof. Rutherford's work is well known on the Continent of Europe as well as in England.

LITERARY NOTES.

The October number of The Canadian Magazine maintains the standard of that publication. The brilliantly and artistically colored cover announces seven short stories and seven leading articles. These are duly found within, together with a couple of poems by Canadian writers.

The C. W. Hunt Company, West New Brighton, N. Y., has just issued three new catalogues from the press. They are: No. 9,805—"Industrial" Railways; No. 9,807—Mast and Gaff Fittings, Coal Tubs, Hoisting Blocks, Wheelbarrows; No. 9,811—Manila Rope for Hoisting and Power Transmission.

The Canadian General Electric Co. has just issued a catalogue, which is neat and attractive in a high degree. The different departments are fully taken up and the various apparatus fully described. Among other interesting features of this catalogue is the department devoted to electric heating. There are innumerable appliances which are for the comfort of mankind, from flat irons to chafing dishes, and are fully described and illustrated.

The Street Railway Journal for September, 1898, is largely devoted to matters of interest to the delegates to the fifteenth annual convention of the American Street Railway Association, held in Boston, September 6th to 9th. The street railways of Boston are fully described. From cover to cover the issue is a triumph of journalism. From a business standpoint the 284 pages of advertisements are sufficient tribute to the skill and success of the management, while the 119 pages of reading matter are contributed by the most able writers and are magnificently illustrated. The full report of the proceedings of the convention is found in the October number of the Journal.

Hand-book of Corliss Steam Engines, by F. W. Shillitto, jr., is a very interesting and instructive work of over two hundred pages, which describes in a comprehensive manner the erection of engines, the adjustment of the Corliss valve gear, and the care and management of Corliss steam engines. Under the head of erecting the following subjects each receive discussion in a separate chapter: Preparing foundations, reference lines for locating, templates, foundations, placing main parts in position, lining and leveling, assembling the moving parts. Under the head adjusting Corliss valves the following chapters are found: The valves, valve gears, squaring the valves, dash pot rods, eccentric rod, rocker arm and reach rod, centring the engine, setting the eccentric, adjusting the governor, indicator diagrams, a few pointers on double ported valve and long range cut-off, tables and memoranda, etc., as well as seven chapters describing different varieties of the Corliss engine.

THE DISPOSAL OF SEWAGE IN EUROPE.

At the meeting of the American Public Health Association recently held in Ottawa, Thomas Macfarlane, chief analyst, Inland Revenue Department, read a paper entitled, Remarks on the Systems of Refuse Disposal in Various European Cities. The cities in question were London, Birmingham, Manchester, Oldham, Rochdale, Glasgow, Hawick, Berlin, Leipsic, Freiberg, Bremen and Braunschweig, all of which the author visited in the summer of 1896. The essential features were described of the ten different systems of disposal in use in these cities, and their disadvantages and merits were commented on from the point of view of the agricultural chemist. Nearly all of these systems leave a great deal to be desired, and Mr. Macfarlane tries to indicate the direction in which he thinks improvement would be possible. In large cities where access to the sea is impossible, and where the water carriage system for excreta has been adopted, it is suggested that storm and surface water should be excluded from the sewage, thorough comminution effected of the solids in the latter, and utilization of the fertilizing constituents on sewage farms of sufficient extent. For other cities, towns and villages the author recommends the introduction of the Mop-Litter system as practiced in Bremen, and other German towns. As examples in Canada of these two methods of treatment it is pointed out that the first is in use at the asylum for the insane in London, Ont., and the second at Grand Hotel, Caledonia Springs.

EUROPEAN METHODS OF TESTING SEWER PIPES OF CEMENT AND CLAY.

The International Association for the Testing of Materials, in 1896, appointed a committee to investigate the methods of testing sewer-pipes of cement and clay, as up to that time there had been no uniform method of testing, and practice varied widely. Mr. Gary, chief of the section for the tests of materials, at the test laboratory at Charlottenburg, was directed to take charge of this investigation, and his preliminary report is published in "Les Materiaux de Construction," Nos. 23, 24, the official organ of the association. Mr. Gary, in 1895, had already investigated, for the German Association of Manufacturers of Portland Cement, the methods employed by governments, municipalities and individuals in testing the strength of cement pipes. He found that these tests varied in each case, and none were regarded as complete for the purpose intended. Similar conditions existed in other countries than Germany.

In the investigation to be made Mr. Gary concluded that the points to be determined were as follows: The resistance to internal and external pressure; impermeability; resistance to the attack of acids; and the wear upon the interior by sand passing with the water. The tests should then mainly determine the bursting and crushing strength, and the texture and composition of the paste used. The resistance to exterior pressure is the most important property in a cement or clay pipe; for, with a few exceptions, such pipes are simply covered with earth or sand, and are not placed in masonry. The pressure upon them will differ as these pipes are laid under traveled streets, under railway embankments, or under the foundation walls of buildings; and it is necessary, in passing judgment upon the fitness of these pipes, to distinguish between the loads to which they are to be subjected in use. Mr. Gary then details the practice of a number of German cities in the test of cement pipe, as follows: The Department of Public Works of Liegnitz requires that a cement pipe one meter (3.28 feet) diameter should resist the pressure of a layer of earth 3 meters (9.84 feet) thick; at Rosenheim, pipes covered with 12 to 16 inches of earth should resist the pressure of a heavy vehicle; and at Colmar, when there is any doubt of the solidity of a pipe, a loaded wagon is passed over the laid pipe. At Schwerin, in Mecklenburg, cement pipes must resist, without cracking, a pressure equal to 50 kilograms per linear meter and per centimeter of diameter. This test is made by placing railway rails on the top of the uncovered pipe. The city of Freysing prescribes that the pipe should support a "load of 6,000 kilos, concentrated upon the top of the pipe;" and Passau demands that the pipe resist a pressure of 805 lbs. per lineal foot. At Zeitz, where the pipes are buried 6 to 8 feet beneath the surface, a steam road roller is passed over them before acceptance. Clay pipes, 1 meter diameter, have been tested at Mannheim, by burying them in the earth, with a covering layer about 18 inches thick. Over the pipe was then placed a double plank platform, about 3 inches thick in all, and 3.28 feet square, and on this was placed the test load. The rupturing load was found to be about 28,600 lbs.

For the test pipes of "armed-cement," or cement reinforced by a double iron mesh on the Zisseler system, the engineer of bridges, at Breme, prescribes the following test: The pipe is buried in sand in a solid wooden box; then by means of a cover fitting inside the box a pressure of 7,500 kilos. per running meter, or about 500 lbs. per lineal foot, is applied to the pipe. The pipe is required to stand this pressure without deformation or cracking. For pipes of oval section, 120x96 cm., and sides 6.5 cm. thick, armed with three layers of metallic mesh, a uniform load of 9,000 kilos. per meter, or a little over 600 lbs. per foot, is prescribed. At the Hague the resistance of beton pipes is determined by placing them in a trench and then loading them uniformly on the square meter of horizontal projection. One pipe in each 50 is submitted to this test; and this load is carried up to 12,000 kilos. for pipes 1.5x1 m. and 1.2x0.8 m. At Copenhagen, Emanuel Jensen employs a process for testing pipes of clay and of "armed cement" which has given very satisfactory results. A heavy timber is embedded in the soil, carrying upon one end a heavy counterweight of cement, and near this are two bars of iron, pierced with holes, attached to the sides of the timber. The pipe to be tested is placed in a strong wooden box, nearly filled with sand, and resting upon the timber, and pressure is applied to it by a lever and saddle with the lever support on a pin passing through the holes in the iron bars. The advantage of this process is that the commencement of cracking in the pipe can be noted; though this is of little advantage in the test of clay pipes, as after the appearance of the first crack the pipe will support but little more. But in the case of the Monier and Zisseler construction, where the iron skeleton augments the cohesion of the material, the appearance of the first fissure precedes by some time the final crushing load.

At the test laboratory at Malines, the resistance of pipes to exterior pressure is tested by a Kirkaldy machine; the pipe being placed between two wooden saddles which each embrace one-third of the circumference of the pipe. But as it is difficult to insure contact with all the inequalities of the pipe, the process is not satisfactory. From the report of Mr. Gary it seems, The Engineering News concludes, that about the only sewer pipe tests so far employed relate to the resistance against exterior pressure; and he well remarks that a uniform, systematic and reasonable test of sewer pipe, of various materials, has yet to be devised; or at least, to be introduced, into general practice.

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FIRES OF THE MONTH.

Sept. 6th. The new mill of the estate Masson at Terrebonne, Que., was destroyed, together with a grist mill, and the Terrebonne Electric Light Co.'s plant; loss, estate Masson, $10,000; fully insured; Electric Light Co., $1,500; insurance, $700.——Sept. 13th. D. A. Ghent's carriage factory, Burlington, Ont.; loss, $8,000.——Sept. 15th. The Belleville, Ont., Gas Works were damaged to the extent of $500.——Sept. 16th. The Montreal Street Railway Co.'s car sheds; damages, $200,000; fully insured.——Sept. 18th. W. G. Harris' mill stock and metal premises, Toronto, were burned down; loss, $8,000.

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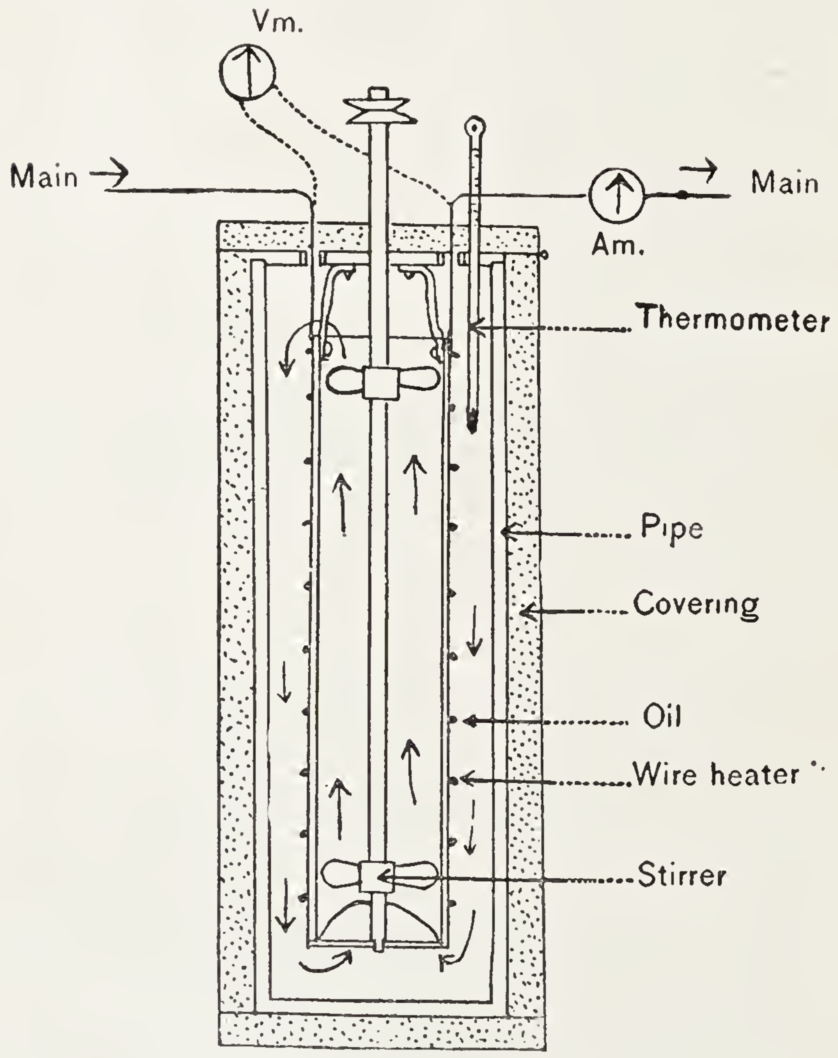
THE TORONTO MAGNETIC OBSERVATORY.

In the February number of The Canadian Engineer was given a brief history of the Toronto Magnetic Observatory and of the troubles that have resulted from the erection of buildings in an all too close proximity to the Observatory, later by various city electrical installations and still more recently by the Toronto electric railway system. In an interview with the Honorable the Minister of Marine and Fisheries in February, 1897, the director of the Observatory suggested that before deciding finally on a removal of the magnetic instruments to another site and breaking one of the longest series of magnetic records outside of Europe, it would be well to invite an expression of opinion from one of the most celebrated magneticians of Europe, several of whom were to be present at the meeting of the British Association for the Advancement of Science in the following August. The Minister was pleased to approve of the suggestion and on the arrival of members of the association the director wrote to the various members of the Kew Committee of the Royal Society who were in Toronto, and also to Dr. Van Ryckevorsel, of Holland, and Professor F. H. Bigelow, of Washington, U.S., requesting the favor of their presence at the Observatory to inspect the photographic magnetic curves there obtained with the view of expressing an opinion as to the advisability of continuing the records at the present site or of removal to some point distant from electric tramways. Prof. Rucker, F.R.S., Prof. Carey Foster, F.R.S., Prof. Fitzgerald, F.R.S., Dr. Van Ryckevorsel and Prof. Frank Bigelow are the gentlemen who courteously accepted the invitation and were pleased to sign a statement that in their opinion the value of the magnetic observations at Toronto had been seriously impaired by the trolley system and advising removal to some other site. Later on, Professor Rucker, speaking at the Massey Hall, stated that Toronto's magnificent electric tramway system had ruined the Observatory. As it was feared that the public on hearing such an expression from the learned members of the association and not recognizing the difference between the Toronto Magnetic Observatory and the central office of the Dominion Meteorological Service, might imagine that a site suitable for the one would be unsuitable for the other, Professor Rucker wrote a letter to the effect that the statements made regarding the Toronto Observatory had reference to the magnetic observations only and had none whatever to the meteorological work there performed. It became evident then that the opinion held by gentlemen engaged in corresponding scientific work abroad, was quite in accord with that of the Director of the Observatory, and shortly after the close of the meeting of the B.A.A.S. he was authorized by the Government to choose and purchase a suitable site for a new magnetic observatory, and after making careful examination as to the distance that the electric currents might effect the magnets, it was decided to erect the new building near the village of Agincourt, a point about 10 miles distant from the present Observatory, easily accessible by railway, and yet very unlikely to be invaded by the trolley system.

The new Observatory, which was commenced in June and finished during the early days of September, consists of two parts, first, a circular stone cellar 19 feet in diameter, the walls two feet in thickness, the floor concrete and the roof covered with felt and gravel, in which, on stone piers sunk in concrete to a depth of six feet below the floor, are placed the self-recording photographic instruments, namely, the declinometer for recording changes in the direction of the magnetic needle, and the bifilar and vertical force instruments for registering respectively changes in the horizontal and vertical components on the earth's magnetism. Above ground and connected with the cellar by a flight of steps is an erection which is divided into two portions, in the larger of which absolute magnetic determinations will be made, piers being provided on which to place the necessary instruments, and an adjustable opening on the roof for transit work, and the smaller an office which will be heated by a copper stove. Observations were first made in the new building on September 16th, and it was hoped that by October 1st all the instruments will have been adjusted in their new position and everything running smoothly. Results already obtained have shown that values will differ but slightly from those obtained at the old Observatory, and it is proposed to make a very careful comparison before dismounting the old eye reading instruments in Toronto. Very great care has been taken in selecting material for the building, every stone used was tested for magnetic effect and none but copper or zinc nails and fastenings have been used. There appears to be every prospect that the new Observatory will be admirably suited for the purpose for which it has been designed, and there is strong reason to think that the series of observations at Agincourt will be practically a continuation of the old and valuable series of observations in Toronto. All the photographic records will be sent for development to the central office of the Dominion Meteorological Service.

THE PROTECTION OF STEAM HEATED SURFACES.

An interesting investigation has recently been carried on at the request of Edward Atkinson, having for its first object the discovery of the relative efficiency of several kinds of steam-pipe covering, and second to ascertain the fire risk attained upon this and certain methods and materials for insulation of steam-pipes. An attempt was made to show the gain in economy attendant on the increase and thickness of covering, and to show the exact financial returns which may be expected from the given outlay for covering steam pipes. Charles L. Norton made the experiments during a large part of the years 1896 and 1897, and considerable information is given in the report of these investigations on many minor matters and conditions affecting the transfer of heat from the steam pipe to the surrounding air. In reproducing some of the conclusions reached, as a result of Mr. Norton's experiments, we omit results of the tests of insulating materials, as they are not of great interest to Canadian steam users, but the report of the methods employed, as described in the Technology Quarterly, is given in full.



PLAN OF APPARATUS FOR TESTING STEAM PIPE COVERINGS.

The method adopted is one which, so far as is known, is original. A piece of steam pipe is heated from the inside by electricity. The amount of electrical energy supplied is measured, and hence the amount of heat furnished is known. If the steam pipe is kept at a constant temperature by a given amount of heat, it is because that amount is just equal to the heat it is losing, for if the supply were not equal to the loss, the temperature would rise or fall. In other words, the heat put into the pipe is just equal to the heat lost from it by radiation, convection and conjunction. By measuring the electrical energy supplied, the heat put in can be determined, and hence also the heat taken out or lost. It must be borne in mind that a given amount of electrical energy always produces the same definite amount of heat, the amount of heat furnished by one electrical unit of energy being known with greater accuracy than the amount of heat given out by a pound of steam in condensing.

The apparatus for making tests by this method comprises several pieces of steam pipe of different diameters and lengths, heated electrically within by means of coils of wire in oil. The oil is stirred vigorously and serves as a very efficient carrier to heat from the wires to the pipes. A brief description of the smallest tester may make the details of the apparatus more easily understood. A section is shown in the figure.

A piece of 4-inch steam pipe, 18 inches long, is closed at one end by a plate welding in, and at the other end by a tightly fitting cover. This pipe is then filled with cylinder oil, and a coil of wire of sufficient carrying capacity, and a stirrer are introduced into the coil. A thermometer is inserted in such a position as to record the temperature of the oil. An ammeter and voltmeter or a wattmeter may then be connected so as to record the amount of electrical energy supplied. The stirring must be brisk, and if enough power is put into the stirrer, to be comparable with the electrical energy supplied, such amount must of course be added, as it also is converted into heat. The apparatus is suspended in the middle of the room on non-conducting cords, and the thermometer read with a telescope, so that no heat from the person of the observer may be added to the supply given to the cover from within, and also that care may be taken not to produce air currents by walking near the apparatus during a test.

In making a test the following operations are carried out, and observations are taken in the following order:

The current is turned on, and heat is generated in the wire coil until the wire, oil and steam pipe have reached the desired temperature at which it is proposed to test. The current is then gradually diminished, until it is found to be of just the amount necessary to keep the pipe at this temperature without a rise or fall of one-tenth of a degree in 30 minutes. A reading of the voltage and current is now taken at intervals of 30 seconds, and the Watts and B.T.U. are computed from their average. We then have the number of B.T.U. lost from the outside of this particular pipe at this particular temperature. If, now, there is placed a steam-pipe cover around the pipe, it is found that a less amount of energy is sufficient to keep it at the required temperature, the difference being the amount of heat saved by the covering. The minimum length of time considered sufficient for equalization of heat, or "soaking in," to the cover, is 6 hours. If, after a second heating of 6 hours, no change in the conducting power is noted, the cover is considered in a permanent condition, and is tested. Some covers, notably those composed wholly or in part of wool, cannot be considered dry and constant until after an exposure upon a pipe at 200 pounds pressure for 6 or 8 days. Covers containing sulphite of lime are also slow in drying.

The three thermometers used were frequently standardized in naphthaline, and were examined to note any disagreement among themselves. All tests were made at a temperature corresponding to 200 pounds steam pressure.

A comparative test was made in 1895, upon a number of steam-pipe covers on a 4-inch tester, 16 inches long. The results obtained have been published in the circulars issued by the Boston Manufacturers' Mutual Fire Insurance Company, and by the Steam Users' Association. The values given were stated to be purely relative, the specimen being too small to give reliable data on the absolute conduction, and the surrounding conditions not being controlled other than to maintain them constant during the several runs. The ends of the specimen were covered by massive heads, and the whole tester was situated within a few inches of brick wall and a stone pier. It was said that the heat loss was probably high, and while the exposure may have been such as to make it so, being a rather harsh test, yet one which was rigidly uniform in its requirements of the several covers. In short, the actual loss of heat per square foot of the pipe surface was correct for that particular piece, under the conditions of the test, but was not sufficient for the estimation of the actual saving which might be expected from the general use of coverings. It was deemed wise, therefore, to construct new heaters, 4 and 10 inches in diameter, and 36 inches long. These were suspended by non-conducting cords in the centre of the laboratory, so as to hang freely and not be in contact with any conducting supports. Conduction up to the lead wires and stirring rod was found to be negligible.

This seems to have approached more nearly the conditions of actual practice than can be obtained by any other method of testing, except the actual use of a long run of pipe, and the determination of the amount of heat put into such a pipe by the "condensation" method, offers many difficulties, and is open to much uncertainty. Therefore, in adopting this method, a reasonable exposure of the pipe is used, and there is an exceptionally good opportunity to measure the heat supplied.

THE INFLUENCE OF PAVEMENTS ON PUBLIC HEALTH.*

BY A. W. CAMPBELL, C.E., PROVINCIAL ROAD COMMISSIONER FOR ONTARIO.

In presenting to this association a paper on the sanitary aspect of pavements, I have been actuated by a desire to obtain information, rather than to impart it. Ontario has so recently developed from a wilderness into the home of civilization and culture; our villages have grown so quickly into towns, our towns into cities, and the advance of the various sciences has been so rapid, that our people scarcely realize the changed circumstances and the need of carefully directing their energies in meeting the demands of the times. In my visits to different parts of the province I am constantly met with evidences of the good wrought by this association. I find that in very small villages even, inefficient drainage, cess-pools, piggeries, slaughter-houses, and impure water supplies are not now tolerated as they were once, and that this is due to the work of your association. It is with considerable hope, therefore, that I have undertaken to briefly lay before you the subject of pavements and public health, confident that you will lend your assistance in aiding our knowledge of this as of other matters pertaining to perfect sanitation; and that where reform is needed your aid will be afforded.

There is no one paving material which possesses every quality desired in a pavement to meet all conditions and uses. The ideal pavement remains to be discovered; but the features which should belong to such an ideal pavement are so numerous and of such varying character as to render the search apparently a hopeless one. The ideal pavement: 1, should be cheap and economical of maintenance; 2, should be durable; 3, should suit all classes of traffic; 4, should offer little resistance to traction; 5, should give a good foot-hold to horses; 6, should be adapted to all grades; 7, should have a good appearance; 8, should not be muddy nor pervious to water; 9, should be sanitary, that is, non-absorbent, not subject to decay, easily cleaned, not dusty, not noisy.

It is apparent then that, notwithstanding the importance of the sanitary aspect of a pavement, there are other features which must be considered. The primary intention of a pavement is to accommodate travel, and to provide one which will do this satisfactorily, which will be durable, cheap, of good appearance, healthful, and possess in the highest degree the other qualities enumerated, in view of the location, nature and extent of traffic, is the problem which presents itself to the paving engineer. Just as no absolutely perfect paving for every time and place has been discovered, it is doubtful if any paving material now used should be utterly condemned. Each has its place in which, until the ideal universal pavement is found, it will be more satisfactory than any other which could be used under that particular set of circumstances of soil, climate, traffic, etc. The purpose of this paper, however, is to treat of the healthfulness of paving in general, of the sanitary aspect of commonly used paving materials; that is, asphalt, stone blocks, vitrified brick, cedar block, and broken stone (macadam), with respect to absorption, decay, ease of cleaning, dustiness and noise.

Of all these, cedar block has received the greatest censure on the score of unhealthiness. Dr. O. W. Wright, a health officer of Detroit, is quoted as saying: "On sanitary grounds I must earnestly protest against the use of wooden block pavements. Such blocks, laid endwise, not only absorb water which dissolves out the albuminoid matter that acts as a putrefactive leaven, but also absorbs an infusion of horse manure and a great quantity of horse-urine dropped on the street. The lower end of the blocks, resting on boards, clay or sand, soon becomes covered with a fungoid growth thoroughly saturated with albuminous extract and the excreta of animals in a liquid, putrescible form. These wooden pavements undergo a decomposition in the warm season, and add to the unwholesomeness of the city. The street, in fact, might as well be covered a foot deep with rotting barnyard manure so far as unwholesomeness is concerned. Moreover, the interstices between the blocks and the perforations of decay allow the foul liquids of the surface to flow through, supersaturating the earth beneath, and constantly adding to the putrefying mass." Cedar block has been condemned in similar terms by many others. On the other hand, Col. Heywood, Engineer of the city of London, England, has said: "It has been said that wood pavements at all times smell offensively and may be unhealthy; but although some city streets have been paved with wood for thirty years, no complaints that I am aware of have been made to the commission on this head, and the inhabitants at all times have not only expressed great anxiety lest the wood should be replaced by other materials, but have subscribed towards the cost of its renewal. . . . I have at times noticed offensive emanations from it near cab-stands, but am unable to find further evidence of its unhealthiness. These remarks must be held to apply only to public streets open to the sun and air, and traffic; in confined places and under some conditions, wood might be objectionable. I have seen it decaying in confined places without traffic."

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*A paper read before the Association of Medical Health Officers of Ontario.

The one statement by the Medical Health Officer of Detroit refers directly to the cedar-block pavement as we understand it in this country. The other opinion, that of Col. Heywood of London, is expressed regarding the wooden pavement as laid in European countries. Between these two pavements there is a vast difference. Under European practice, many of the pavements are of the Karri and Jarrah woods of Australia which are thoroughly saturated with resins, are very hard and are not subject to decay. They are sawn into brick like blocks and laid on concrete. Where soft woods are used, they are also cut into regular oblong blocks and laid on concrete; and are saturated with creosote or treated with some other preservative process. Wooden pavements of America, however, represented by cedar-block, are of a very different order. The round blocks, of irregular diameter, are merely the untreated wood, still carrying the bark. These, placed on a bed of sand, are under the most favorable conditions possible for decay, being constantly exposed to moisture, air and warmth. With no preservative treatment they are enabled to absorb to the fullest extent all forms of liquid street filth which, in the process of putrefaction, feeds on the organic matter of the wood. The surface, which quickly becomes uneven, retains a large quantity of loose matter subject to decay, the whole giving rise at times to noxious odors. The effect, were sufficient of such paving used, would subject us to the conditions favorable to marsh fever. From a sanitary standpoint the cedar-block pavement of this country would indicate a serious menace to health. At the same time, while we are justified as a matter of theory in arriving at this result, there do not appear to be any statistics to prove the conclusion to be a correct one. The death-rate of cities most largely paved with cedar-block does not bear any ratio to the extent of such pavement; nor does a change from cedar-block to another less absorbent pavement produce a noticeable effect on the death-rate.

In European practice, wood more suited to a business street than macadam, affording a better foot-hold for horses than asphalt, less noisy than granite setts, is exceedingly popular in spite of its less sanitary character. In this country, however, there is an unwillingness to renew a wooden pavement when decay has rendered it unfit for further use, and this, coupled with the less careful method of laying, is the cause of the complete disrepute into which it has fallen. Experiments have been made recently by a Polish scientist with regard to cedar-block. The bacteriological examinations showed that, in specimens taken from blocks which had been in use for four years, and from a depth of one centimeter and two centimeters below the surface, there were at the end of five days 650,000, 220,000, and 12,100 bacteria per gramme of wood. A later examination showed 1,200,000 colonies per gramme in the surface of the wood, and 8,600 colonies per gramme at two centimeters below the surface. An estimate, in terms of its nitrogen, was made of the organic matter absorbed by the wood, and indicated that the surface layer of wood contains more nitrogen than the most polluted soil. A comparative estimate of the pollution of the atmosphere was made by placing a definite quantity of sulphuric acid under a glass bell, on the surface of wooden and asphalt pavements, the result, as indicated by the quantity of ammonia absorbed by the acid, being much in favor of asphalt. The observations show that while a wooden pavement gives absolute protection to the soil and to the subsoil water, there was considerable atmosphere contamination. The experiments were made on blocks of pine, preserved by impregnation with copper sulphate. Such being the case with a wooden pavement laid under European practice, there can be little doubt of the unwholesome effect of cedar-block upon the atmosphere. Further experiments of this description, conducted by members of your association, would doubtless prove instructive and profitable.

Broken stone or macadam would next arouse suspicion with regard to its absorptive qualities. There is this great difference between the two, however, that whereas a wooden pavement itself decays and affords food for the decay of other organic matter falling on it, the macadam does not in itself decay. With under-drainage such as well-built macadam roads possess, it should be little more than a good sewage disposal bed for the comparatively small amount of sewage which falls upon it. A macadam pavement can be scraped and swept, it is not noisy, dust can be subdued by sprinkling, and on sanitary grounds appears to be an excellent pavement for residential streets where traffic is not excessive. For business streets, or for heavily traveled thoroughfares of cities, a harder surface is advisable.

With regard to absorption, there can be no objection to asphalt, vitrified bricks nor stone blocks. Asphalt is impervious to water; while the joints of brick or stone pavements are practically perfect so far as absorption is concerned. To be sanitary a pavement should not be dusty. The dust of a pavement is not only an irritant, but carries with it the bacteria of disease which, from various sources, are a part of street filth. To prevent dust the pavement must be so perfectly cleaned that a practically harmless amount is taken up by the wind; or if perfect cleanliness is not possible, dust must be subdued by sprinkling. Unless perfectly cleaned, much more perfectly cleaned than is commonly the case in this country, an asphalt pavement is very apt to be a disagreeably dusty pavement on a windy day in summer. This, indeed, is one of its greatest faults from a sanitary standpoint. Toronto has the reputation of being a clean city, with a well-organized street department, yet even under these favorable conditions, a walk or drive down Yonge street on a warm, windy day is a very trying experience. The smooth, hot surface quickly dries any matter falling upon it, a wheel passing over this dry substance grinds it to powder, and the result is that clouds of dust find their way into the eyes, nose, mouth, throat and lungs of pedestrians. Business men in their offices are not safe from its attack, as it drifts in through the open windows. The dust imbeds itself in clothing, fastens itself on articles of food exposed in the shops, to be eaten finally by the purchaser. One case came to my notice in which a consumptive patient was ordered by his physician to leave Jarvis street, one of the best residence streets of Toronto, because of the dust which came from the asphalted roadway. These streets are swept by machines, and are hand-swept by a corps of city employees, but are not to my knowledge flushed as are similar pavements in London and Paris. Flushing is the only method whereby asphalt can be freed from this unsanitary dustiness, but in addition to being expensive and hurtful to the asphalt, such a proposal will doubtless meet the disapprobation of the engineer in charge of sewers. The dust, however, is not a defect of the pavement so much as it is a fault in the method of cleaning. Asphalt has, nevertheless, the disadvantage of being a very hot pavement. Its smooth surface, reflecting back the heat and light, is productive at times of sun-stroke, and the glare is frequently painful to the eyes. This is most noticeable in closely built business sections where there is least circulation of air, where the sun beats down between high brick walls; and is not so objectionable on a shady residential street with houses well apart. Vitrified brick and stone block pavements are neither so dusty nor hot as asphalt since the surfaces are less smooth and assist in retaining in the joints the finer particles of dust. Sprinkling, too, is in a greater measure effective in subduing dust on brick or stone block than on asphalt, from the hot, smooth surface of which moisture evaporates rapidly. A macadam pavement is dusty if not properly treated, but it scraped and swept as are other pavements, the dust can be largely subdued by sprinkling. Noisiness, if excessive, is another unsanitary feature. A noisy pavement is jarring to the nerves, grating upon the sensibilities, and for either a heavily traveled business street, or a residential quarter, a quiet pavement is much to be desired. Noise itself is not always unhealthy. It is doubtful if the workman in a boiler factory, or a railroad engineer or other employee, is much influenced by the noise incidental to his occupation. Both are muscular of body, constantly taking vigorous exercise. But to the more sedentary man of business, whether at high nervous tension in his office or resting in the quiet of his home, a din, constant or intermittent, is a source of annoyance, and as such, is wearing on the nervous system. The most objectionable in this regard is granite or other stone block pavement. Vitrified brick is apt, unless great precautions are taken, to create a disagreeable rumbling. Asphalt, wood and macadam are the least objectionable with respect to noise.

While we have this to say of the comparative healthfulness of different varieties of pavements, there is another condition of matters common to too many towns and cities, in which the streets in fall and spring form a wilderness of mud and stagnant pools, and in summer are shapeless beds of dust. Many of them are made the receptacles of the refuse from private property, which is left to disfigure the street, forming rivers of filth and cess-pools of disease. Such streets have been regarded as a zero quantity, doing no particular harm, doing no particular good. Streets, however, which do no good, should do good, and therein lies the harm. A good street is a well-drained street, a well-cleaned street, and is a source of healthfulness to the members of the community. Streets should be the public parks, pleasing to the cultivated taste, adding to the culture and refinement of the people, and enticing them to breath health and vigor, whether walking, bicycling, riding or driving. Passing along the city street we reach the country highway, which, as a means of permitting the people of the city to leave the congested portions and to reside in the less thickly populated suburbs, forms an important factor in securing public health.

WOOD CARBONIZATION.

In the destructive distillation of wood, that is, ordinary charcoal burning, there are in the smoke or gas several valuable substances. These substances have been known for a long time and some have been partially recovered. The first process employed for the purpose was that for the production of tar from pine wood. Later, on the continent of Europe and in Scotland, wood was burned in retorts and the pyroligneous (that is crude acetic acid), was made into acetate of lime. Of late years, however, this business has had a very great development in the United States, where the large amount of excellent hardwood forests in the natural gas regions, where no wood is used for fuel, has given a very cheap raw material, making possible the export of acetate of lime and wood alcohol to Europe with profit.

THE CHARCOAL KILNS AT DESERONTO, ONT.

At present, there are two distinct processes used, called the kiln process and the retort process. In the kiln process the cord-wood is put into a large brick or stone "beehive" kiln and burned in the ordinary manner for producing charcoal, but the smoke or gases do not escape into the air, but are drawn through a chimney into a series of condensers, where all the liquid products are condensed out, and the gas is burned under the boilers. The liquor condensed (amounting to 180 gals. for a cord of well-seasoned dry wood), is led into tanks and the tar is separated out. This tar is re-distilled, producing oils and pitch. If only wood alcohol is to be made, the settled liquor is distilled and crude alcohol produced and the residual pyroligneous acid is run to waste. If brown acetate of lime is to be made, the crude liquor is neutralized with lime before the alcohol is distilled off. If gray acetate of lime is to be produced, the crude liquor is all distilled and purified before neutralizing with lime. This method gives the best product, the gray acetate of lime containing from 82 per cent. to 86 per cent. of acetic acid, while the brown acetate of lime sometimes contains less than 60 per cent. of acid. The retort process differs from the kiln process of carbonizing in having the cord-wood put into horizontal wrought-iron cylinders, and these are heated by a fire-place beneath them. In the kiln process, enough air is let into the kiln to burn a portion of the wood, and this heat serves to carbonize the rest. The retort process is superior to the kiln process in giving larger yields of valuable products, but the cost of installation and of working is greater.

The by-products in the liquors from the condensers are recovered the same way, whether produced by the kiln or retort process. In all the processes the alcohol is re-distilled, purified and treated chemically, and brought up to a strength of 95 per cent., before being put on the market. The products of this industry are used in the arts for various purposes. Wood alcohol or methyl alcohol is like grain alcohol in many physical properties, but is poisonous. It is used for making spirit varnishes for burning and dissolving various gums, and by the government for making methylated spirit. Acetate of lime is used for the production of acetic acid, which is the acid of vinegar, and is diluted and flavored and sold for this purpose in Russia and other European countries.

The Standard Chemical Co., Limited, first introduced the retort system into Canada about a year and a half ago at Fenelon Falls, Ont. Previous to this, the only works in Canada turning out these wood products, were located at Deseronto, and owned by The Rathbun Co., which owned the patents for the Burrel

Kiln process. H. O. Chute, superintendent of the company, was employed by the Standard Chemical Co. to erect a retort plant at Fenelon Falls, which has been in operation since last fall. When the Deseronto Iron Co. decide to locate at Deseronto, assuring a market for the charcoal, the Standard Chemical Co. acquired the rights of the Burrel patent, owned by the Rathbun Co., and decided to enlarge the plant by putting in retorts. This plant will have the largest single bench of retorts in the world, and many new features of construction are being introduced, which allow of a more economical working and handling of all products by machinery. We are indebted to H. O. Chute, superintendent of the Standard Chemical Co., for the information contained in this article.

THE OTTAWA VALLEY CANAL.

The report of the special committee of the Dominion Senate, appointed to examine into the feasibility and advantages of a water-way connecting Lake Huron with the St. Lawrence, via the Ottawa river, has been published, and is accompanied by three maps of the proposed Montreal, Ottawa, and Georgian Bay Canal, including a plan and profile. The report as issued seems to be entirely in favor of the construction of the work. The witnesses examined, who included S. A. Thompson, Duluth, U.S.; Major-General Gascoigne, at the time Commander of the Canadian Militia; Marcus Smith, M. Inst. C.E., Ottawa; James Meldrum, M. Inst. C.E., London, Eng.; O. Higman, Dominion Electrician, Ottawa, and H. K. Wicksteed, C.E., Cobourg, Ont. A series of questions were also sent out to a large number of those who might be supposed to be either most familiar with the locality and the nature of the construction required in the particular work in question, or whose knowledge of like questions and of transportation generally gave their opinion weight with the committee. Replies were received, among others, from Sir Wm. Van Horne, Walter Shanley, C.E.; T. C. Clark, M. Inst. C.E., New York; Andrew Bell, C.E., Almonte, Ont., and R. W. Shepherd, Man. Dir. of the Ottawa River Navigation Co.

The bright side of the picture seems to have been presented to the Senate more fully than the reverse. There are several features of the proposed work which are not very fully dwelt on in the report. The estimates of the cost discussed were largely those proposed for a twelve-foot waterway, and the canal under discussion is to have a depth of fourteen feet. The report of T. C. Clark, M. Inst. C.E., made in 1860, is quoted, in which he says: "The distance is 430.76 miles, of this 351.81 miles are already a perfect natural navigation, and require no improvement, and it is perfectly practicable so to improve the remaining 78.95 miles as to convert the whole chain of water into a first-class navigation for steam vessels, and to reduce the length of canaling 29.32 miles, or exclusive of the Lachine Canal, to 20.82." In the late report he says: "To improve the navigation of such a river system is comparatively easy, for the greater part is already accomplished." Marcus Smith, M. Inst. C.E., in his evidence before the committee, says of the river stretch: "I think there is only one place in the Ottawa that we need to make any dredging at all for twelve feet, but there may be some more for fourteen feet." The evidence seems to point to the use of the Ottawa river as part of the canal in its present state, or when improved at a comparatively low cost. The witnesses, who were heard through their answers to the series of questions, had not the same opportunity to bring forward all the facts at their command as had those who were examined by the committee. Andrew Bell, C.E., is quoted in the report as speaking enthusiastically of the electrical possibilities of the water along the canal, but does not give any evidence as to the condition of the lower Ottawa. Mr. Bell was the engineer in charge of the construction of a government dam in the Ottawa river at Carillon, and is very well posted on the subject of the Ottawa river. In an article published in THE CANADIAN ENGINEER in August, 1897, Mr. Bell says: "At present not more than eight feet depth for navigation can be depended on between Lachine and Ottawa city, in low water." Some of the engineers giving evidence were in doubt as to nature of the bottom of the Ottawa. Mr. Bell made extensive surveys, 1870—1882, from above Grenville to below Carillon, and (by an assistant), above and below St. Ann, and he states that "the lower Ottawa flows over limestone rock." There appears then to be a very serious problem in adapting the present navigation of the Ottawa to the demands for increased depth. The report made by the Senate committee seems to show how incomplete is the information before the public, and how necessary it is that a careful examination of the whole place should be made, and preliminary surveys carried out before the government affords any assistance to the scheme, either by a money grant, or by lending its credit by a guarantee of interest per term of years, as has been proposed.

In a paper read before the Royal Society of Canada in 1893, T. C. Keefer, C.E., C.M.G., stated that: "The Ottawa route would be most valuable to Lakes Michigan and Superior ports, as affording much the shortest water route to tide-water at Montreal, and also at New York, via Lake Champlain, if the barge system of transportation proves to be the most efficient and economical. Hydraulic lifts, or pneumatic locks, may yet bring the shorter and shallower water routes into competition with the St. Lawrence; but as long as boats are kept in their native element, the broad deep channel of the St. Lawrence will remain the only one which can successfully compete with the railways."

FIRE-PROOF BUILDINGS.

BY FRANCIS C. MOORE.

(Concluded from last issue).

Well-holes should be avoided if the building is to be regarded as "fire-proof." It is almost impossible to control a fire starting in the lower floors where a well-hole opens through those above. Luxfer Prisms are now used to secure light from side windows, it is claimed, with great success. A recent fire test of the Luxfer Prism, in Chicago (March, 1898), is stated to have been satisfactory to Fire Marshal Swenie, as showing that these prisms afford material protection from the heat of a neighboring fire in an exposing building, and that, to some extent, they are substitutes for iron shutters. These should be in hallways cut off from the rooms at each story by fire walls and doors, to prevent draughts. It is not so important, and is not so practicable, in the case of office and hotel buildings as in the case of mercantile and manufacturing buildings; but it is advisable, even in office buildings, to have the staircases, elevators, etc., in a separate hallway, the division walls of which should extend through and above the roof, and any skylights should be covered with glass not less than ¼ inch thick. It is contended by some that skylights should be of thin glass, so that they will break easily and permit the escape of smoke and gas. Smoke is inflammable, and when it accumulates in a building, often spreads the fire from story to story, or blows out the walls by the explosion of its gases. But while thin skylights are contended for by many expert firemen, it should be borne in mind that nothing so facilitates the spread of fire as a draught, and it would be better to have the skylights adjusted with appliances for opening them, so that when the firemen arrive on the ground, and not before, they may be adjusted to permit the escape of smoke and allow the firemen to enter the building to see where to work to the best advantage. Under any circumstances a network of wire should be above the glass to guard it against flying embers, and another should be suspended beneath the skylights, so that when the glass cracks and breaks with the heat it will not injure the firemen below.

Roofs should be of brick or tile on all high buildings, the roof beams being of iron and, where tanks are supported, of sufficient strength to carry many times the actual probable weight of the water and the containing tank itself. Slate roofs, on very high buildings especially, on street fronts are objectionable, as, in case of fire, the slates would crack and, falling to the street, injure the firemen. A flat roof of brick tile is better than any other. All water on roofs from rain or melting snow should be drained from the front or sides to leaders, so as to avoid drip points, from which icicles could be formed.

The electric light installation of a "fire-proof" building is an important and complicated matter. The switchboard should be of combustible material, and no steam, water, or sprinkler pipes should pass over or near it where, in case of a bursting pipe, water could reach the switchboard and cause disaster. This is an important matter almost universally overlooked. An admirable floor for a dynamo room is one of deck glass, ¾ inches thick, on a wooden (not iron) frame. It will insure that the attendant upon the dynamos will be, at all times, effectually insulated. Such a floor will not become soaked with oil, as would a wooden floor, and can easily be kept clean. A strip of rubber floor carpet stretched over it will prevent slipping.

It is sometimes necessary to have communications between adjoining buildings by doors in the fire walls, and it is not always convenient, for changing merchandise from one room to another, to have "fire-proof" doors closed during working hours. It is possible to have the "fire-proof" doors run upon trolleys on an inclined track, so as to close by the force of gravity and held open by fusible metal latches or links which would release them when melted by the rising temperature of a fire. It has occurred to me that this difficulty may also be met by erecting between two adjoining buildings a separating "fire-proof" hallway of brick, which can be utilized for containing staircases and elevators, and for supporting the water tanks of automatic sprinklers. The doors which open into this hallway should not be opposite each other, but at opposite ends of it, so that fire in one of the buildings passing through the door would come against a blank wall opposite. Even if the "fire-proof" doors to these openings should happen to be open at the time of a fire in one of the two buildings, it is improbable that it would find access to the other. The floors should be both fire and water proof, slightly lower than those of the two separated buildings, and with water vents or "scuppers" for carrying off surplus water thrown by a fire department. Indeed, it is well to have "scuppers" on all floors of every building. The walls of this separating hallway should rise 4 feet higher than the roofs of the two buildings, and, if there are window or door openings near it, its walls should project beyond the line of enclosing walls at least 1 foot.

The water tank, as already stated, should be supported on protected iron I-beams, resting on the brick walls, with cast-iron templates, so that the tank cannot fall, break down the staircases and wreck the building in case of fire. It is important always to locate tanks so that they will not be over stairways or elevators, and endanger them in case the supports give way. With a "fire-proof" hallway of the kind recommended, containing no combustible material whatever, the tanks being supported by iron I-beams resting on the brick walls, this would not be an important matter, but in all other cases water tanks should be planned so as not to endanger staircases, and the supporting iron beams should be "fire-proofed," that is, covered with "fire-proof" material. It ought to be unnecessary to state that there should be no combustible material whatever in this separating hallway, and that the staircase, elevators, etc., should be of metal and "fire-proof." Indeed, such a hallway as this could be relied upon to separate wooden buildings. It should, however, for that purpose, be at least 10 feet higher than the peak of their roofs, and should extend 4 feet beyond their front and rear lines.

Where it is not necessary to transfer merchandise from one building to another, and only requisite to have a passageway for employees, this may be arranged by an iron balcony, like a fire escape, cutting down the window on each side of the separating wall for a door, so that communication can be had by the balcony. The openings should have "fire-proof" doors. This would be practically safe. It might, with iron ladders, be utilized as a fire escape, and so prove of great advantage to firemen in fighting a fire, who could hold a hose nozzle at the different windows with perfect safety to the last moment. It is practicable, indeed, to have iron stairways with roofed balconies entirely outside of storage stores so that the floors do not communicate. There are a number of these in Philadelphia.

These should not be of iron, but of wood covered with tin. Solid iron shutters or doors are not reliable. Iron doors yield readily to flame, resulting sometimes in their warping open when exposed to fire in an adjoining building, exposing the one they are intended to protect to the full effect of the flames. Where window openings are protected by iron shutters on rear courts they are almost certain to be opened by a fire in an exposing building, and cannot be relied upon. The tin covered wood shutters are alone reliable. There is no recorded instance in which a solid iron door, exposed to the full effect of fire in an adjoining building, has protected the opening, whereas there is, on the other hand, no recorded instance in which the "Underwriters'" door has failed to serve its purpose—two important facts which are significant and ought to settle the question. The "Underwriters'" door is constructed of ordinary white pine lumber, free from knots, of double or treble thickness, according to width of opening, the boards being nailed diagonally and covered with the best quality of tin, with lap-welded joints. It ought to be unnecessary to state that on the exposed side of a building, not only the shutter, but the window-frame, sash, etc., should be of metal or covered with metal—riveted, not soldered. Where it is not possible to use a "fire-proof" shutter for want of room, wire glass in a metal frame will be found a desirable substitute. It will probably hold a fire until the fire department can cope with it. It is not generally understood nor known that fire will travel from one story to others above by way of the windows in the outer or enclosing walls. Especially where a building has an enclosed court, it will sometimes reach upper stories in this way, even when the floors themselves are thoroughly cut off, the court acting as a chimney.

It may be well to suggest for the benefit of those who are not familiar with city fires that, as heat naturally ascends, the exposure of a low building is often much greater to a neighbor higher than itself than to a building of its own height, so that a tall, "fire-proof" structure, surrounded by smaller buildings, should be provided with fire shutters to all openings. These are not necessary where the exposing buildings are occupied for offices, and are themselves "fire-proof," as the amount of heat which escapes from the windows of a burning building, so long as its enclosing walls remain intact, is seldom sufficient to ignite a "fire-proof" building or its contents. The moment of greatest danger is when a burning building collapses, and the intense heat caused by its enormous bed of coals, exerts its full effect upon surrounding structures. In a recent fire in New York three "fire-proof" office buildings were more or less damaged with their contents, although many feet away from the burning building. It is to be hoped that some inventive genius will devise a plan for simultaneously opening or closing the shutters on any or all stories of high buildings by manipulation from the ground floor. They are usually left open at night, always in the day time, and might thus be closed in case of a dangerous fire in the vicinity. In some cases they are fastened open.

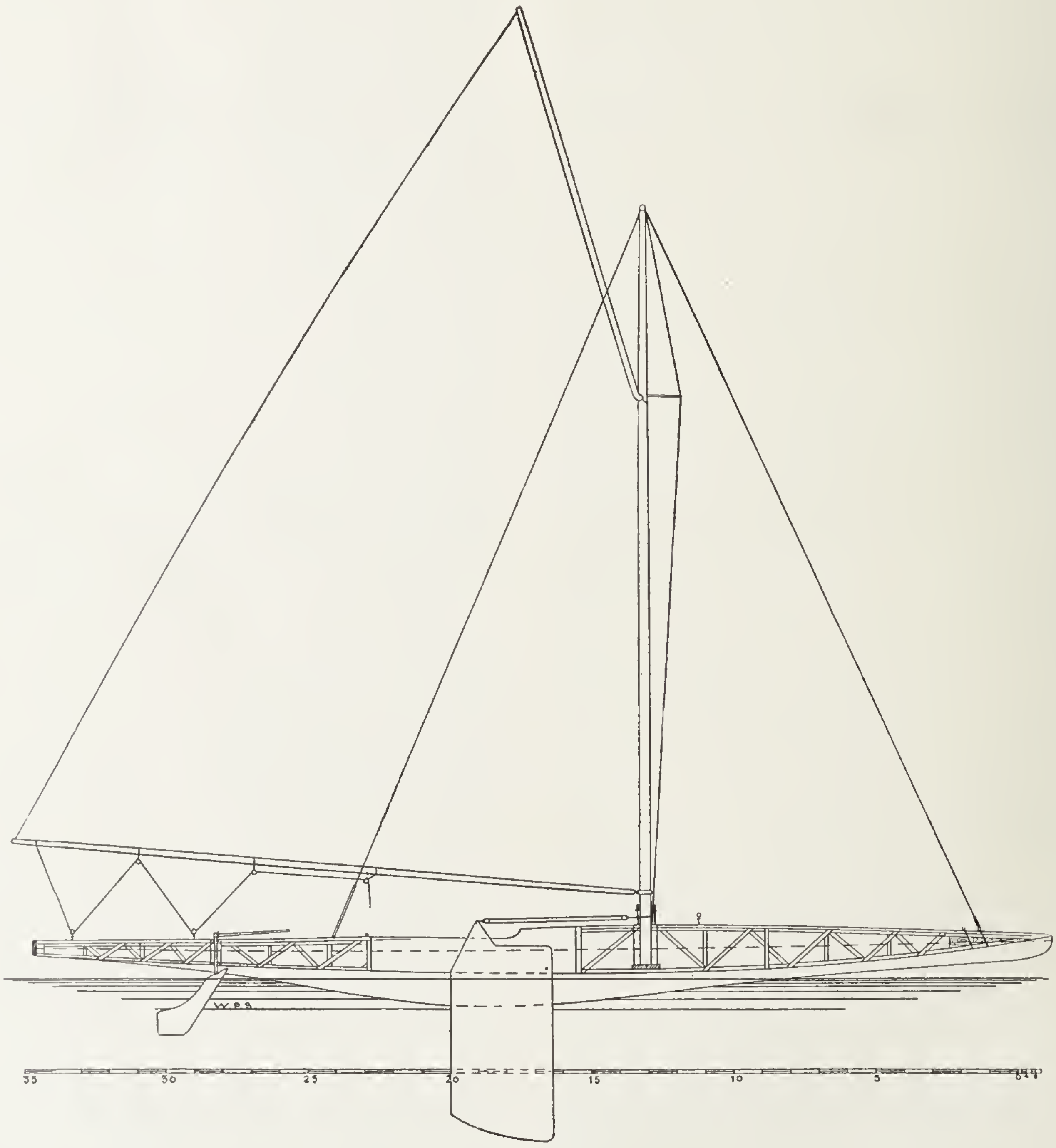
Tests of "fire-proof" material, iron beams, pillars, floor arches, etc., to be of any value must be conducted under circumstances which insure uniform conditions. Otherwise comparisons are unreliable. It is quite customary to refer to results of fires in different buildings, having differing forms of construction, as supporting theories of relative merit; but ordinary conflagrations cannot be relied upon, for the reason that in two buildings, side by side, the conditions may be widely different.

Eddies and currents of air, changes of prevailing wind, etc., may secure exemption from damage. It happened in the large conflagrations of Chicago, Troy, Boston, etc., that the most phenomenal escapes were observed. In some instances frame buildings, surrounded by brick structures which were totally destroyed, escaped with no further damage than the blistering of paint.

Even where tests are carefully arranged, especially weigh tests, obvious precautions are sometimes overlooked. It will be observed, for instance, where bricks are piled on a surface of floor arch and iron beams to secure a certain weight per square foot, the pile of bricks may be so disposed as to have a bearing on both of the iron beams, and the full weight may not come upon the "fire-proof" arch between them. The lateral bond of a pile of bricks a few courses higher than the floor to be tested may have all the effect of a relieving arch and materially reduce the strains. In furnaces constructed to secure high temperatures, drafts and currents of air should be provided for with great care and under the direction of the most competent and intelligent experts.

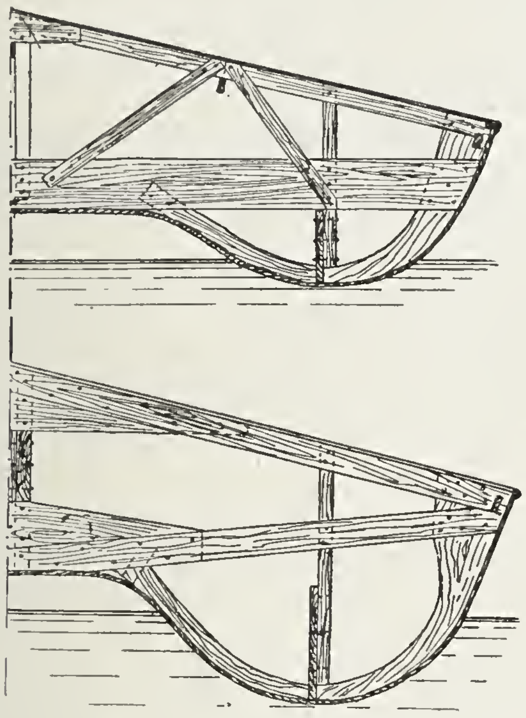
THE DOMINION.

The 20-foot yacht Dominion, built to defend the Seawanhaka international challenge cup, upon the design of G. Herrick Duggan of the Dominion Bridge Co., Montreal, is a racing machine which has already aroused a lively discussion that is likely to result sooner or later in a radical revision of the rules governing the class, and possibly of the general rule governing all the smaller classes, says Forest and Stream, from whose pages we reproduce the accompanying plans. The situation at the present time seems to be that either this new type must be recognized as legitimate in all classes, or some material change of the rules must be made to bar the entire scow type to which she belongs. The dimensions of Dominion are: Length over all, 35 ft. 10 in., l.w.l. 17 ft. 6 in.; beam, extreme, 7 ft. 7½ in., l.w.l. over all, 7 ft. 1½ in., l.w.l., one bilge, 2 ft. 5½ in.; draft, hull, 10 in., with board, 6 ft.; freeboard, 1 ft.; sheer, bow, 3 in., stern, none; displacement, 1750 lbs.; area midship section, total, 2.88 sq. ft.; sail area, 500 sq. ft.

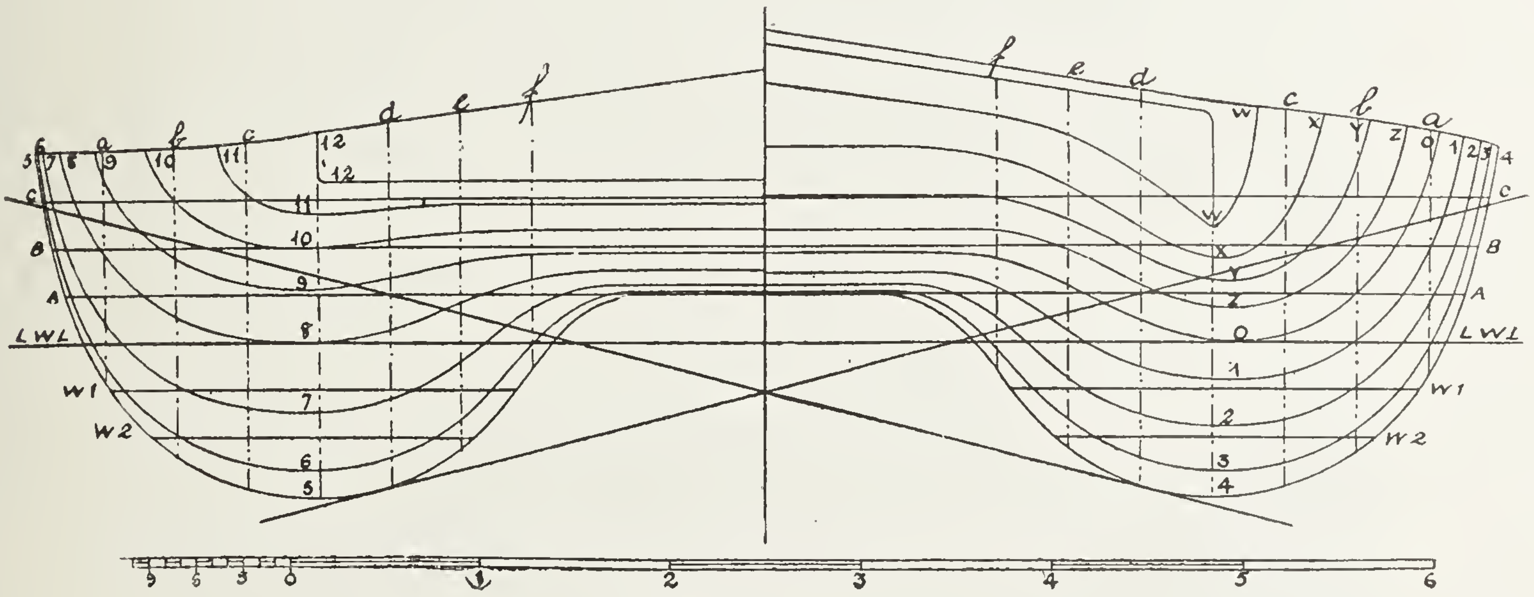


Dominion Sail Plan.

In many details Dominion is no more remarkable than others of the 20-foot class produced within the past two years. The "barn door" deck plan has been seen on other boats. The notable departure that has aroused so much hostile criticism is the hollowing of the floor, so plainly shown in the body plan. The object of this is to perfect the form of the bilge when sailing (as all the boats of the class are sailed) at an extreme angle of heel, and with the entire weather side of the boat clear of the water. The rig and general fittings are much the same as in other of Mr. Duggan's boats, Speculator and Strathcona of this year, and Glencairn, Avoca, Glenowen and others of last year. The centreboard is built up of wood and sheet steel, weighing about 250 lbs., or about 150 lbs. less than in last year's boats; it is situated amidships, in the centre of the hull, as in the other boats. The rudder is of a different form from last year, very wide below, but is of the same construction, a light iron tube for stock, two sheet steel sides, and wood filling, making a strong and light piece of work. The rig is of the same length on the foot, and the centre of effort is at the same height as in Glencairn II., but the gaff is peaked up, making a higher rig. All of Mr. Duggan's sail plans this year show these same proportions, looking like Momo of last year. One of the peculiar features of Dominion is the shape of her deck. The boats of last year were distinguished by a great crown and a peculiar curve to the beams; this year, in Dominion, the curve has been abandoned, each side of the deck running up straight to a ridge in the centre, like the roof of a house. This plan gives a great depth where it is needed, above the highest part of the floor, and especially for the housing of the mast, it aids in the transverse trussing, and it gives a weather deck that in sailing is flat and almost level. The cockpit is comparatively small, but it is carried down to the bottom, its floor being merely light strips laid on the floors. There are no bulkheads, the boat being open from end to end. The great length of the yacht, the large area of deck, the limited depth, due to the hollow under the floor, and the fact that only one side of the hull is water-borne at a time, with the absolute necessity for a light hull, made the problem of construction a difficult one; but it was successfully solved by Mr. Duggan, who planned the entire construction and followed it closely during the building; the yacht being built at the shop of the Yacht Company of Canada, on the yacht club grounds at Dorval. So far as tested by the trial trips, practice sails, trial and cup races, the construction is a success in the important detail of strength, as the boat showed no signs of strain. One special point in favor of the construction is that only the cheapest and simplest materials were used, such as are found in any boat shop, and there was no call for special skill on the part of the workman.



Dominion—Section Showing Construction.



Dominion—Body Plan.

The first point in the construction was to secure a sufficient depth of hull amidships, by means of a central ridge, giving depth for a fore and aft girder, and also stiffening the transverse trusses. The fore and aft trusses are located, one in the centre of each bilge and the third exactly between these two, in the centre of the hull. The lower member of each side truss is a vertical keelson of ⅝-in. white pine, 8 inches wide amidships; the posts are of white pine 1 by 1 inch, and the diagonals of the same wood 3 by ½ inch. There are transverse trusses spaced 2 ft. 2 in., forming the main and deck frame, also of ½-inch white pine, from 1¼ inch to 3 inches wide, the curved members being merely sawed off from straight stuff without regard to the grain. The members were carefully disposed and well fastened by numerous boat rivets. At the two after stations under the travelers, solid frames are used, and at the partners solid planks are used above the level of the middle floor. The skin is laid shiplap, of about three-eighths thickness, with three light bent frames between each of the trusses. The deck is also laid shiplap, just under three-eighth inches. The weakest point in boats of this class has been about the mast, there usually being no keel or keelson to carry the weight. In Dominion the mast step is suspended by four three-eighth inch steel bolts from two fore and aft pieces of oak, about 2 by 2 in., running over the top of the transverse trusses and transmitting the strain to several of them. In this way there is no direct strain on one point of the bottom. The construction, as a whole, is simple, cheap, homogeneous and apparently amply strong and durable. In these respects it compares favorably with that of the Crane boats, which was ingenious and carefully worked out, but at the same time calls for material unknown in boat shops and unfamiliar to the average boatbuilder, and depending for success on the use of metal in combination with wood instead of one material alone.

WATER POWERS OF ONTARIO.*

BY THOMAS W. GIBSON.

In speaking at Buffalo, N. Y., January 12th, 1897, on the occasion of the introduction into that city of electric power from Niagara Falls, Mr. Nikola Tesla, perhaps the most celebrated of living electricians, spoke of a tremendous problem yet to be solved in the production of power, to the elucidation of which he had devoted a great deal of attention. Without describing the nature of this problem, he spoke of it as an effort to "evolve means for obtaining energy from stores which are forever inexhaustible, to perfect methods which do not imply consumption and waste of any material whatever." Even if this stupendous achievement were accomplished however (as he had little doubt it would be), he said his investigations led him to conclude that "under the theoretically best conditions such a method of obtaining power cannot equal in economy, simplicity and many other features the present method involving a conversion of the mechanical energy of running water into electrical energy, and the transmission of the latter in the form of currents of very high tension to great distances. Provided therefore that we can avail ourselves of currents of sufficiently high tension, a waterfall affords us the most advantageous means of getting power from the sun sufficient for all our wants, and this recognition has impressed me strongly with the future importance of the water power, not so much of its commercial value, though it may be very great, but chiefly of its bearing upon our safety and welfare."

If Mr. Tesla's conclusion be correct, namely, that a waterfall affords us the most advantageous means of getting power from the sun for all our wants, excelling for this purpose not only muscular force, but wind and steam as well, the rocky uplands of northern and western Ontario may yet be reckoned among the most valuable parts of the province by reason of the vast number of waterfalls situated there. The main watershed dividing the system of the great lakes from that of Hudson Bay runs in a northwesterly direction from the eastern boundary of the province north of lake Temiscamingue to the head of lake St. Joseph on the northern boundary, a distance of about 500 miles. It consists of a tableland or plateau rather than a sharply defined ridge, and is estimated to have an average width of about 70 miles, or an area of about 35,000 square miles, thus with the slopes on both sides affording an extensive catchment surface for the streams running to the north and south. Its elevation will average perhaps 1,400 or 1,500 feet above the level of the sea, or 900 feet above lakes Huron and Superior. In places it approaches the shore of the latter lake, and for the greater part of its extent is situated at a comparatively short distance from either of these bodies of water. The consequence is that the rivers and streams which flow from it into the great lakes, though mostly of considerable volume, are not of great length, and their descent is therefore usually rapid and abrupt, and marked in many places by cascades and falls.

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*Extracted from the report of the Ontario Bureau of Mines, 1898. Vol. V Part III.

The value of a river of given volume for purposes of water power does not altogether, or even chiefly, depend upon the amount of its fall from source to mouth. Of course the greater the fall the greater the energy possessed by the stream as a whole. But it is apparent that if the descent be gradual and uniform, or approximately so, there will be few places in its course where the fall is large enough to afford any considerable quantity of power. It is only where sudden falls or rapids occur, which create a decided difference in the level of the water, that the energy of the river is concentrated, as it were, within a short space, and can be utilized. The nature of the soil or surface of the country through which the river runs has an important effect in influencing the habit of the stream in this respect, and so determining its value as a producer of power. If it be composed of sand, clay, gravel or even the softer and more easily decomposed rocks, it will usually be found that the river has worn its bed to a fairly uniform slope throughout, in which case there will be few opportunities of developing power from its waters. Even if a slight drop should occur, a dam would probably be required in order to obtain any considerable head, and the erection of dams, while often necessary and advantageous, involves additional expense both in construction and maintenance. In a river whose bed is composed of hard rock, such as is usually comprised in the Laurentian and Huronian formations of northern and western Ontario, the eroding force of the water meets with much greater resistance, and its course is more likely to be marked by abrupt changes of level in rapids and falls, and indeed this is characteristic of many if not most of the rivers in those parts of the province. Another prominent feature of the topography of these districts is the very large number of lakes, varying in size from mere ponds to large and important sheets of water. These are either the sources of or tributary to the rivers, or expansions of them, and act as reservoirs or storage basins, tending to regulate the flow of the water and to render it constant and steady throughout the year.

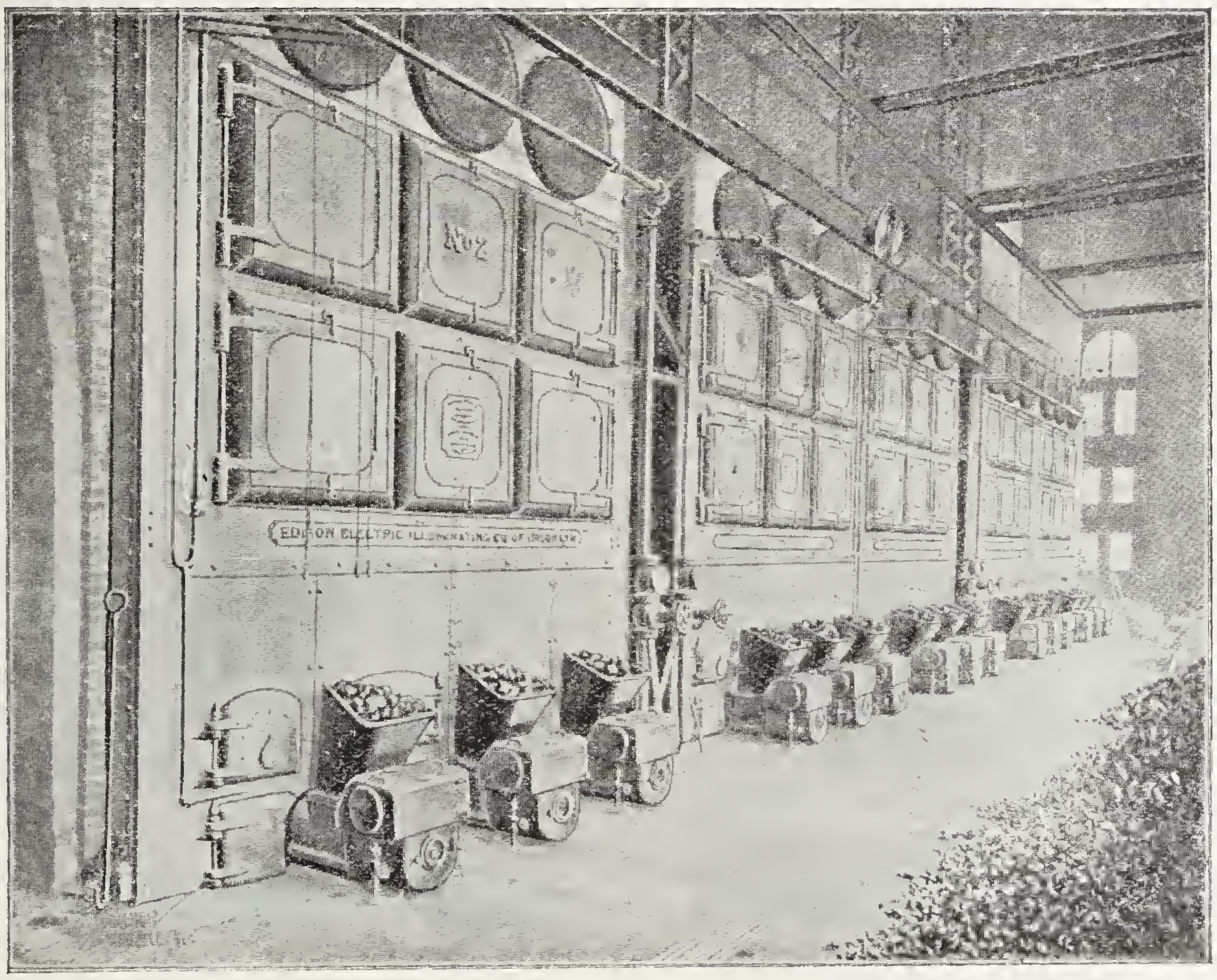
The character of the country in northern and western Ontario is therefore such as to provide an almost illimitable amount of water power readily available. Taking into account the annual precipitation of moisture in the form of rain and snow, there is no reason to doubt that hundreds of thousands of horse power could be generated from the waters of streams flowing into the great lakes with a minimum of trouble and expense. A shorter watershed running from the main one southwesterly round the western end of lake Superior divides the streams falling into that lake from those which find their way into lake Winnipeg and so into Hudson Bay, and the waters running in both directions from this divide furnish many fine water privileges, similar in character and equally available; while tributary to the Ottawa river, and in that part of the province included within the boundaries of Algonquin National Park, as well as to the south and west, are numerous rivers of considerable fall and volume, from which a very large additional amount of power could with little difficulty be obtained. The streams flowing into Hudson Bay, such as the Albany, Kenogami, Missinaibi, Mattagami and Abitibi are of greater average length than those running into the great lakes, and as they descend to the level of the sea, say 600 feet below that of lakes Superior and Huron, many falls are to be found upon them, particularly in their upper reaches and in the neighborhood of the "long portages," where their waters are interrupted by the hard rocks of the old formations on their way to the more level Devonian plains bordering on James Bay. For the present, however, these rivers are too remote to be regarded as sources of available power, though the time may come when they will be called into requisition. But on the Seine, Atikokan, Wabigoon, Winnipeg and Rainy rivers, on the Mattawin, Kaministiquia, Nepigon, Steel, Pie, Magpie and Michipicoten, on the Mississaga, Thessalon, Spanish, Vermilion, Wahnapitae and Sturgeon, on the Montreal, Ottawa, Petawawa, Bonnechere and Madawaska, on the Muskoka, Maganetawan and Severn, and on many others there are numerous falls and rapids waiting to be utilized and capable of doing the work now being done by all the steam engines in Ontario a hundred or a thousand times over. This is leaving out of view the waterfalls already developed and in use in the older portions of the province, as well as the stupendous energies of the falls of the St. Mary and Niagara rivers, which are already, one on the Canadian and the other on the American side, to some extent made use of.

The rivers enumerated above are situated among the forests of pine and hardwood, which cover so considerable a portion of New Ontario, and in many cases they are contiguous to valuable deposits of ore or mineral. The raw material for many industries lies around them. The sawmill, planing mill, sash and door factory, pulp mill, match factory and many other woodworking industries might happily combine abundant raw material and cheap power on these streams, while stamp mills and other mining plants might be worked with profit and success. Other industries, such as woolen, cotton and flour mills and chemical manufactories might avail themselves of the cheap power without necessarily locating in the immediate neighborhood of the waterfall, by connecting themselves with it by means of the electric current, though for textile, paper and other industries whose processes necessitate the use of large quantities of clear water, a waterfall convenient to means of transportation forms an ideal site. Electrically driven railways seem likely to come into vogue in this and other parts of the world because of their low first cost and inexpensive maintenance, and it appears feasible to operate electric roads by currents generated by the waterfalls on the rivers in many parts of the districts referred to. Such railways might serve a very useful purpose in carrying lumber, ore, raw and finished material and supplies of all kinds in a country where perhaps the volume of traffic might not be sufficient to render an ordinary steam railway a profitable undertaking.

Water power, whether employed directly to operate machinery, or converted into electric energy for the same purpose, has many advantages over the steam engine. For the same quantity of power, its first cost is not usually much greater, and often not so great, and once installed it requires little or no attention. Its danger to life and property is less. It needs no fuel, a consideration specially important in Ontario, which has no coal beds, and where in time even the present abundant supplies of wood will be exhausted. Hitherto the chief disadvantage of water power has been its immobility. If a waterfall was not conveniently situated, it was of little or no use. If it did not pay to place a manufactory alongside a waterfall, the fall could not be brought to the factory. Now this has to a large extent been changed and power can be delivered without serious waste many miles from where it is electrically produced. The change will be still more marked when the problem of transmitting electric energy through long distances has been thoroughly solved, and Nikola Tesla looks forward to a speedy solution.

The presence of so many available water powers in the Lake of the Woods, Seine River, Wahnapitae and other mining districts of Ontario is a fortunate circumstance, and cannot but have a very favorable effect upon their development. Cheap power means economy in working, and will permit of ore bodies being profitably utilized which would otherwise not pay for treatment. The immense deposits of low grade ore which are found north of lake Superior and on the Upper Seine are in many cases situated in proximity to waterfalls capable of yielding hundreds and thousands of horse power at comparatively little expense. The importance of preserving these water powers as far as possible for the general benefit and preventing their being locked up in the hands of speculative individuals who would not use them themselves, but who would demand heavy toll for their use by others, has led to the adoption of new regulations under the Act respecting Water Powers, (61 Vict., chap. 8), passed at the last session of the Legislature. The principal features of these regulations are those which provide for the leasing of such powers by the Crown, instead of patenting them outright, and for the furnishing of surplus power by the lessee to others on terms to be fixed in case of disagreement by the Lieutenant-Governor-in-Council.

—The largest dynamo in the world is now being constructed by the Walker Co., of Cleveland, O., for the Boston Elevated Railway, Boston, Mass. This generator will have an output of 3,000 k.w. at 550 volts, or about 4,000 h.p. Its speed will be between 75 and 80 revolutions per minute, its total weight 250,000 lbs., and the diameter of the circular cast-steel field frame 21 feet, 7 inches. The weight of this ring without field magnets will be 25 tons. There will be 24 inwardly projecting laminated cores and pole having a combined weight of 15 tons. The armature hub is 13 feet in diameter and is in two parts, each of which weighs 10 tons. The shaft is 37 inches in diameter. The armature laminations add 15 tons, and the armature will have in all 594 slots. The commutator will be 105 inches in diameter, and will have 1,188 bars. To facilitate regulation and remove a portion of the strain from the shaft, the flywheel will be bolted directly to extensions on the armature hub. If this machine were to run at the speed of the Niagara generators, 300 revolutions per minute, it would have an output of 16,000 h.p.



PLANT EQUIPPED BY THE AMERICAN STOKER CO., SHOWING THE AUTOMATIC STOKERS AS IN USE AT UNION STATION, EDISON ELECTRIC ILLUMINATING CO., BROOKLYN, N.Y.

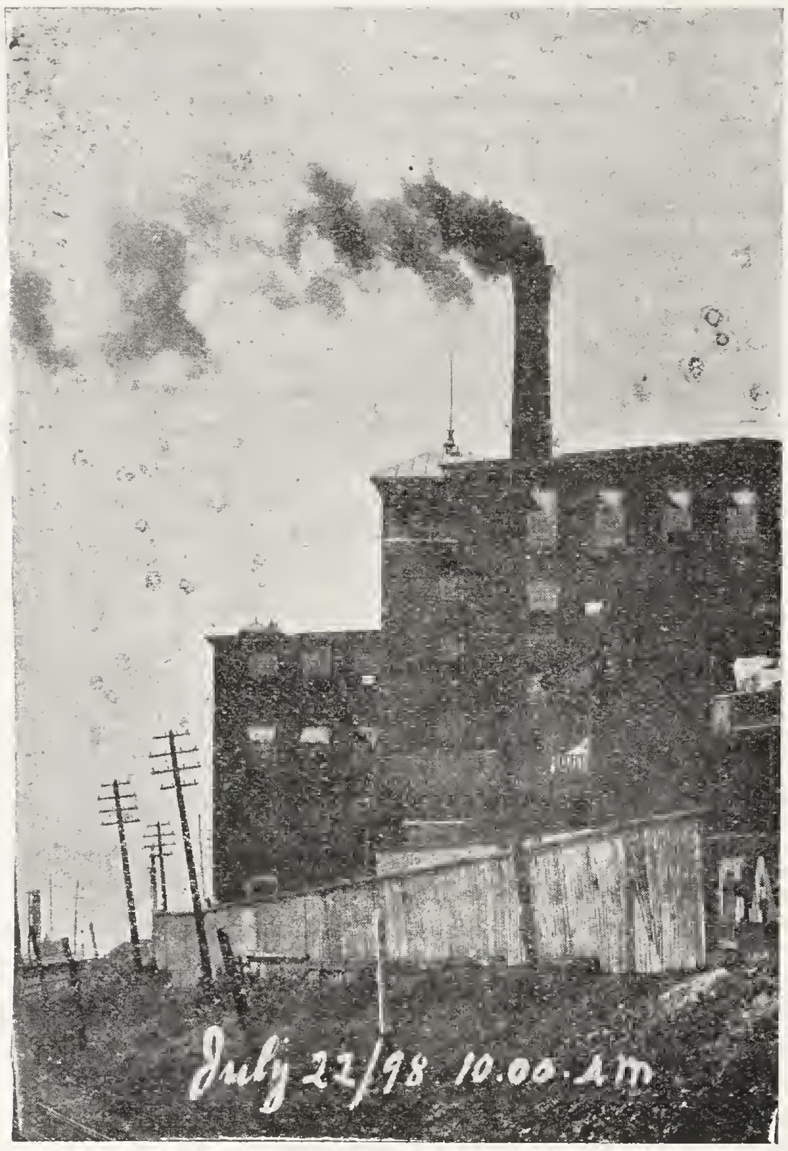
ACETYLENE GAS LIGHTING FOR TRAINS.

In response to an enquiry as to the progress being made in car lighting by acetylene gas, A. Holland & Son, Ottawa, Ont., write that they are adopting a new system, because though the generators in use on the Pontiac & Pacific and Gatineau Valley railways give beautiful light it has been found they are troublesome to keep clean and charge, and the overflow of gas causes a bad smell in the car that is very offensive to some persons. Mr. Ressman, who is fully impressed with the future of acetylene as a car lighting gas, urged Mr. Holland to try and make a machine that would absolutely control the gas and do away with the principal difficulty—the odor from escaping gas. In view of the experience he had he discarded galvanized iron generators with rubber connections entirely, and a system that depended entirely on a water seal to retain the gas. "My new generator," writes Mr. Holland, "is made entirely of cast iron, with iron pipe connections and brass valves. It made its trial trip on Oct. 11th in a Gatineau Valley car. It proved to be a perfect success. The lights burned brilliantly throughout the trip, lasting 4½ hours. With six lights of 25 c.p. each the car was illuminated so well that I could read the evening papers with comfort from any seat in it. The vibration over the roughest part of the road had no effect on the lights, and better than all there was absolutely no overflow or leakage of gas. I am now at work on another apparatus designed specially for locomotive head lights. I expect to have it in operation shortly, and that it will be as complete a success as the car lighter."

THE AMERICAN STOKER COMPANY.

We publish herewith a series of engravings made from photographs representing the Dominion Cotton Company's Mill at Hochelaga, Que., prior to and after the installation of the American Stoker Company's apparatus in the boiler house. The second series of pictures almost give the impression that the mill is closed down, but on entering the mill, however, it is found that everything is in full swing, and on going into the boiler house at the time these photographs were taken, it was seen that the whole of the steam plant of about 700 h.p. was in operation, the boilers being fired by means of the American Stoker Co.'s apparatus with soft coal screenings. The photographs were taken at the request of the Dominion Cotton Co., by Mr. Dennison, photographer, St. Catherine street, Montreal, and Mr. Dennison went to the site and took these photographs without the knowledge of any one connected with the cotton mill. The series is taken at intervals of ten minutes to show that no special advantage was taken in selecting the moment of exposure.

The stoker is thus described by its makers: "Immediately beneath the coal hopper, and communicating with it, is the conveyor pipe; this in turn communicating with the coal magazine. A screw conveyor or worm is located in the conveyor



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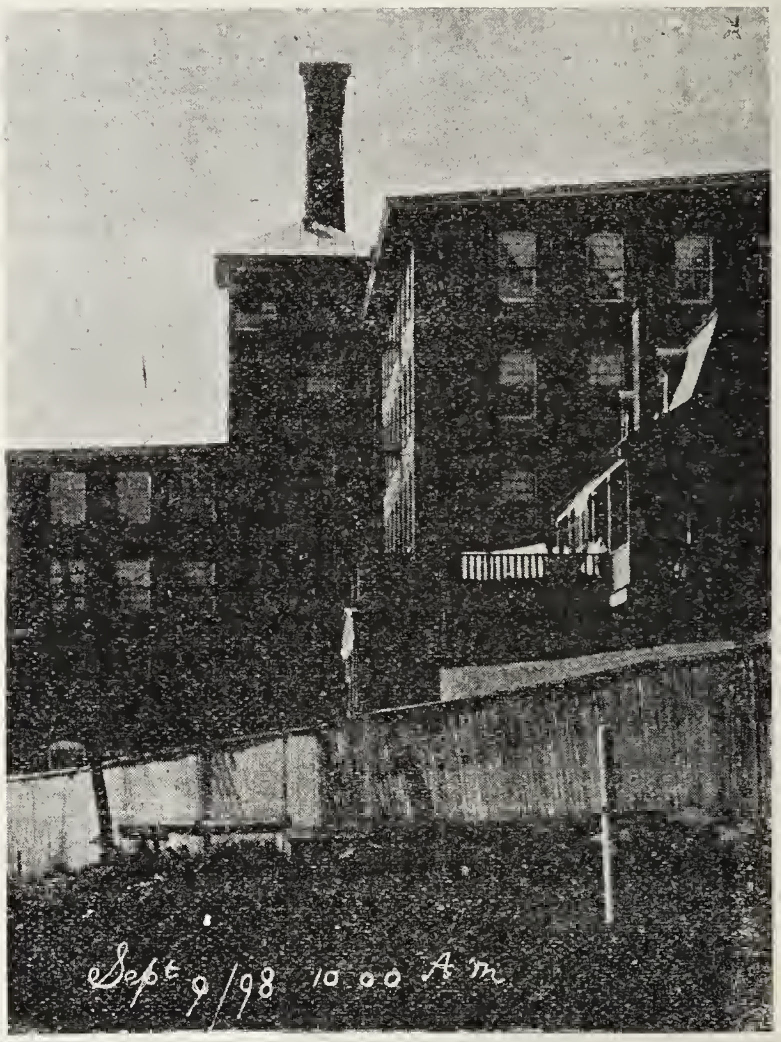

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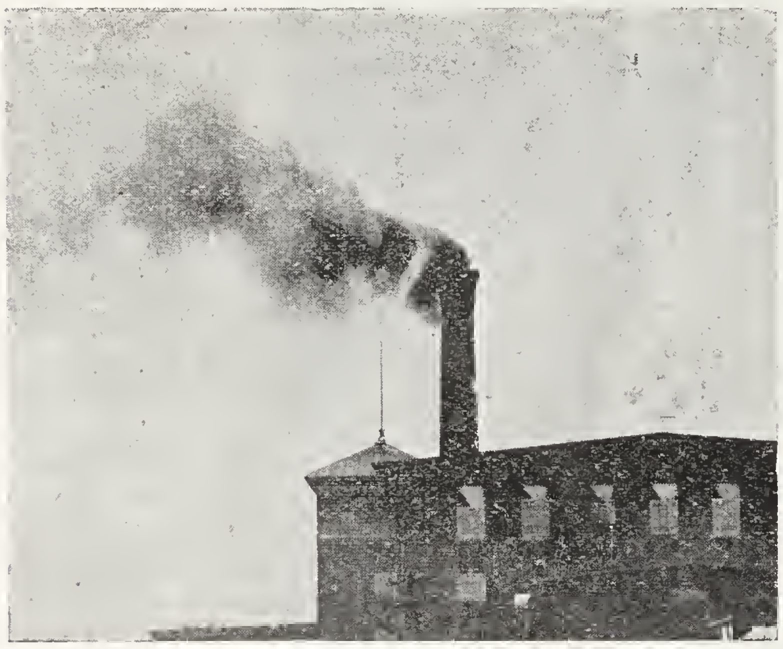

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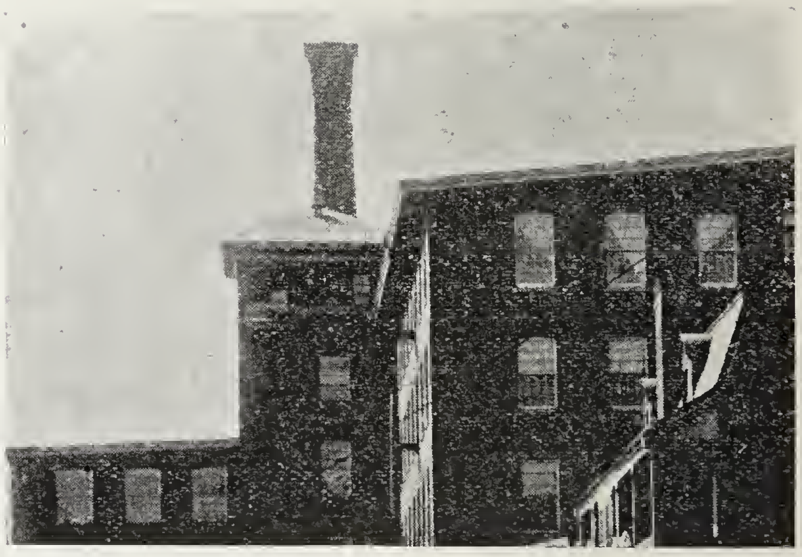

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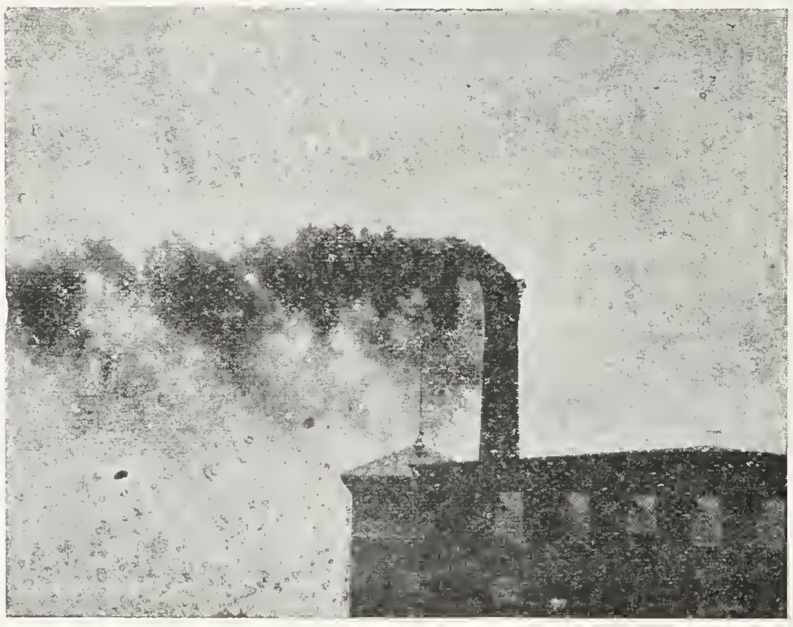

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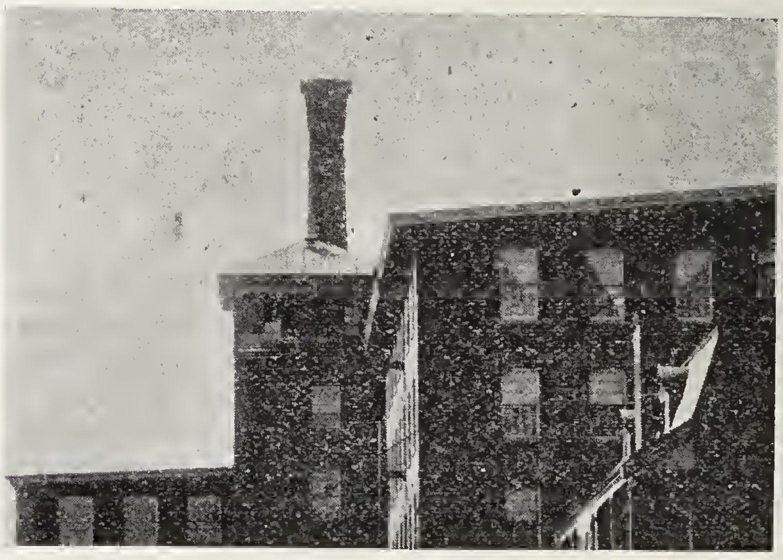

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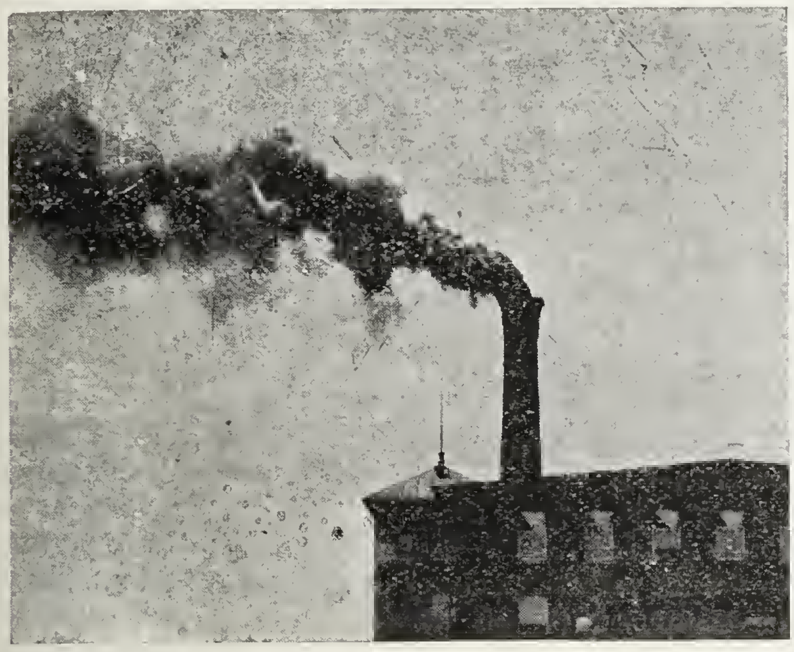

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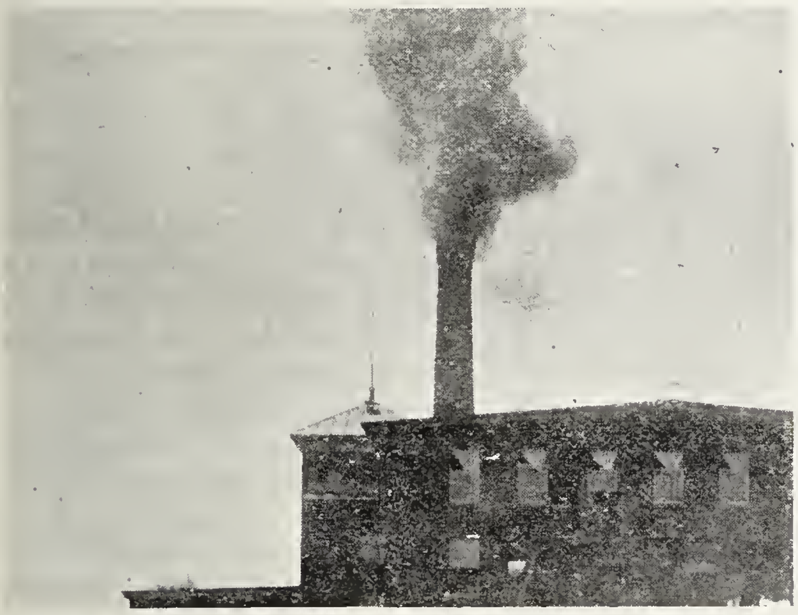

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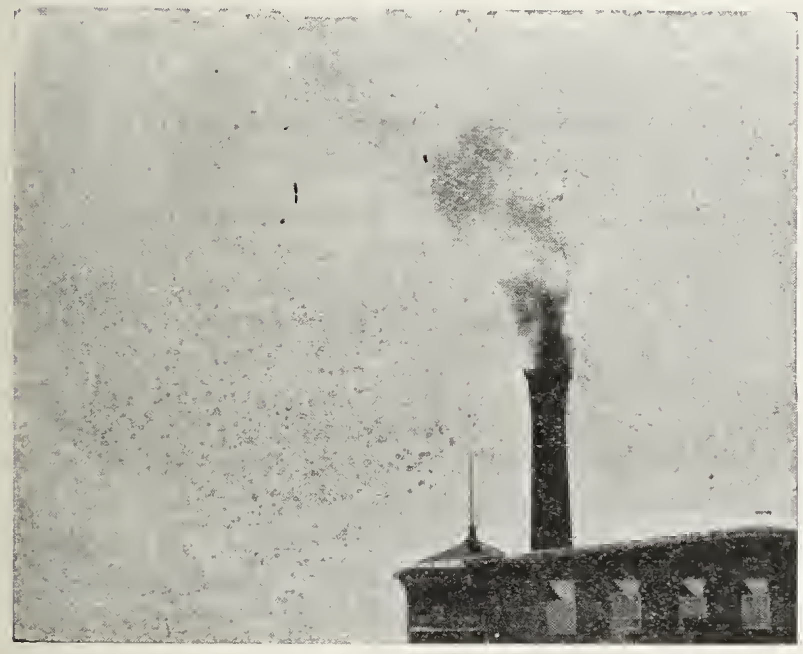

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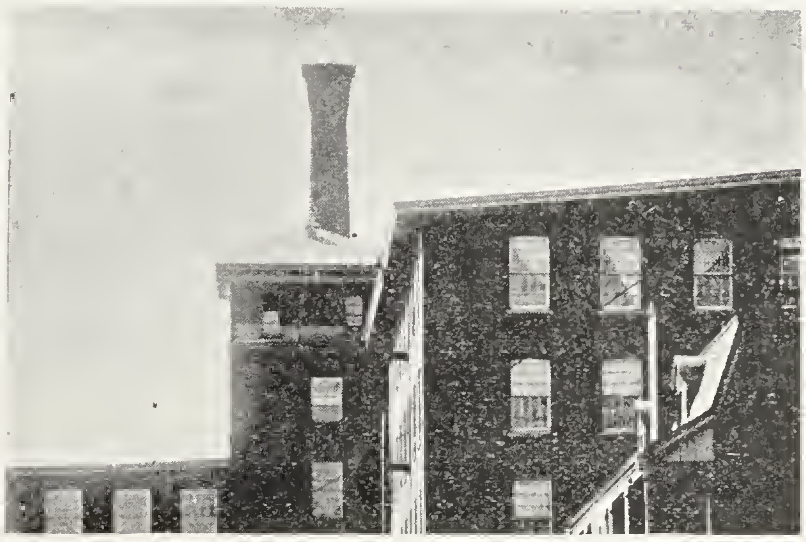

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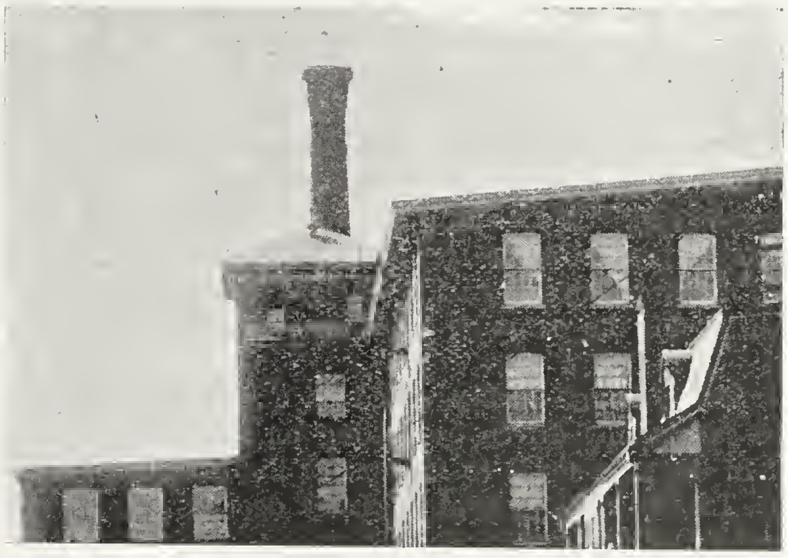

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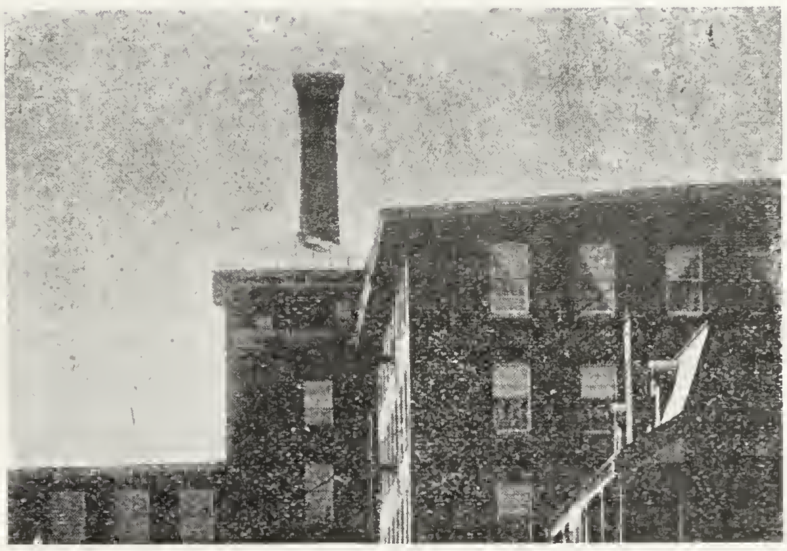

Sept. 9th, 1898—10.50 a.m.

pipe and extends the entire length of the magazine. Immediately beneath the conveyor pipe is located the wind box, having an opening beneath the hopper. At this point is connected the piping for the air supply, furnished at low pressure by a volume blower. The other end of the wind box opens into the air space between the magazine and outer casing. The upper edge of the magazine is surrounded by tuyeres, or air blocks, these being provided with openings for the discharge of air, inwardly and outwardly. Each stoker is driven independently by a small steam motor, located immediately in front and beneath the hopper. The motor has a simple reciprocating piston. Its piston rod carries a crosshead, which, by means of suitable connecting links, operates a rocker arm having a pawl mechanism, which in turn actuates the ratchet wheel attached to the conveyor shaft. The stoker is thus entirely self-contained and complete in itself, and consequently there is no danger of the driving and feeding mechanism (the only working parts) ever getting out of alignment. The rate of feeding coal is controlled by the speed of the motor, this being effected by the simple means of throttling the steam in the supply pipe to the motor. The shields covering the motor effectually protect the mechanism from dirt and dust. The coal is fed into the hopper, carried by the conveyor into the magazine, which it fills, "overflows" on both sides, and spreads upon the sides of the grates. The coal is fed slowly and continuously, and, approaching the fire in its upward course, it is slowly roasted and coked, and the gases released from it are taken up by the fresh air entering through the tuyeres, which explodes these gases and delivers the coal as coke on the grates above. The continuous feeding gives a breathing motion to this coke bed, thus keeping it open and free for the circulation of air. We call particular attention to the fact that every pound of coal fed into the hoppers passes through this gas-making process, and there is no loss of coal through grates, by reason of the use of dead grates in the furnace, in place of open grate bars. The non-combustible is taken from the furnace in the shape of vitrified clinker. There is practically no soot, and with these results it is obvious that the combustion must be extraordinarily good.

"With our ability to feed the finest of slack coal we also handle lump coal, as any lump that can be fed into the hoppers will be crushed by the conveyor, there being provided a set of teeth, placed at the mouth of the conveyor, against which the coal is squeezed and broken." The American Stoker Company, whose Canadian office is at 54 Street Railway Chambers, Montreal, and is under the charge of W. E. Gower, is equipping quite a number of stokers in various parts of Canada and the United States.

ROPES AND ROPE DRIVING.*

BY L. H. KENYON, DUKINFIELD.

(Concluded from last issue).

Long Centres.—It is still a debatable question as to what distance unsupported ropes will convey power in a horizontal direction. Judging from the admirable manner in which ropes are working at 90 foot centres, the writer would have little hesitation in fixing them at a still greater distance. The main conditions are, well-sustained journals, plenty of room to permit the sag running clear of obstruction, and a liberal allowance for extra weight of rope—back driving, of course, always understood. The limit of endurance would be the same in any diameter of rope, as specific gravity and tensile strength are the same in proportion to the sectional area. For forward driving, much depends upon the diameter of the pulleys being sufficient to lift the outgoing from the incoming part of the rope.

Vertical Driving.—Pulleys fixed on the same vertical line may be successfully driven by putting on extra ropes, as the weight of the rope tends to fall out of the groove instead of into it. In this case, general efficiency depends greatly upon the elasticity of the rope.

Continuous Driving.—In America, Germany, and to a very slight extent in England, a system of rope driving known as the continuous rope, by which the power is transmitted through a single rope wound round the pulleys, is largely in use.

Cross Driving.—Up to this point, the question of rope driving has been treated as relating only to pulleys turning in the same direction. Ropes, however, may be as successfully applied to cross driving, with certain reservations, just as in the case of belts, gaining in frictional power, inasmuch as they cover more pulley surface, but at the expense of the ropes on account of continual contact in passing each other. To avoid the latter contingency as much as possible the pitch of the groove should be twice the usual distance, there being actually double the number of ropes at the crossing points. The ropes should also be crossed alternate ways in order that couplets may travel the same path in agreement and share alike the inevitable rubbing.

Rope and Spur Gearing Combined.—The difficulty of driving with ropes and spurs together, i. e., from one to the other either way, appears to be the result of back lashing, spurs being too rigid to yield to the more definite action of the ropes, which causes them to oscillate from side to side and often fly off the pulleys. It is a mistake to suppose that tightening will obviate these difficulties. This tends only to prevent reciprocal action, and we have known cases where teeth have been stripped as a result of tight ropes. Under such conditions, slack ropes are not only necessary but they should be fixed at different tensions in order to break the harmony without interfering with general efficiency. Each rope will then vibrate to a different rhythm, unless, which is not likely, the measure so arranges itself that unison of action is occasionally produced.

Rope Speed and Power.—Dismissing from our minds the vexed question of centrifugal force and the somewhat complex process of reasoning by which its effect upon high speed is supposed to be ascertained, it may be laid down as a safe rule to follow that a good cotton rope, 1¾-in. diameter, running at 1,000 feet per minute will comfortably transmit 10 h.p., and that this power increases or diminishes in the same ratio as the speed. You may therefore expect this size of rope running at 7,000 feet per minute to transmit 70 h.p. Some of our ropes are, however, transmitting 93 h.p. each at a speed of 7,040 feet per minute, and on one occasion, owing to an accident to its fellow, double this power was for a time transmitted through a single 1¾-in. rope. We understand that an engine is now in process of construction which is designed for a rope speed of 8,000 feet per minute, or rather over 90 miles per hour, and is to transmit 80 h. p. per rope. Even this may ere long be exceeded. At any rate, it appears that the speed limit has not yet been reached. Taking the above relative size, speed, and power for granted, it now only remains to calculate the power of other sizes from the sectional area, which may always be regarded as that of a circle. A rope 1½-in. diameter will then transmit 7.34 h.p. and 1¼-in. diameter 5.1 h.p. per 1,000 feet of speed.

Thin v. Thick Ropes.—Referring to the much contested question of the relative efficiency of thin and thick ropes, actual practice contradicts the oft advanced theory that ropes, say from 1-in. to 1¼-in. diameter, may be run with greater advantage than the thicker sizes, allowing the same relative diameter of pulleys. In the matter of durability thick ropes certainly take the lead, and this may be accounted for by the fact that their wearing surface is greater in proportion to the sectional area: e.g., we will suppose that 2-in. dia. rope is worn ⅛ of an inch all round. This would bring down its actual strength to 1¾-in. diameter only, or as 64 is to 49. The same chafing on a 1-in. rope would reduce its strength to ¾-in. dia. rope, or as 64 is to 36. It may also be mentioned that this fraying is far more pronounced on small than large ropes. Two-inch ropes however, look rather clumsy, are not easily handled in splicing, and necessitate large pulleys. This may to some extent account for 1⅝-in. and 1¾-in. becoming favorite sizes.

Guide Pulleys.—There is scarcely an angle or position of shaft to shaft from which power may not be transmitted by means of ropes and guide pulleys. Take, for instance, the intricate arrangement for driving a spinning mule or traveling crane. It must, however, be noted that every additional pulley beyond the necessary driver and driven takes from the durability of the rope, not only on account of extra friction but from strain and contortion. In consequence of this, the average life of a crane rope is scarcely a tithe that of the ordinary driving rope.

CANADIAN ENGINEERS.

The following extracts are from an address by T. P. Trowern before the C.A.S.E. No. 2, Sept. 9th, 1898:

The term stationary engineer is not the best word in the English language to be applied to a certain class of men; any person would think, if we were not particular about the names we are known by we will not be very particular about our work. The word "stationary" in our dictionary means "fixed, not moving, not advancing, not improving." An engineer is a man who constructs and manages an engine for manufacturers and motive power of all sorts, including naval and military defence. There are mining, canal, lake, civil and sanitary engineers, in fact, all sorts of machinery to be kept in motion and repaired by them. Our medical and surgical men should be classed engineers because they keep the machinery of our bodies in motion. Within the last few years we have had brought to our notice electric, gas, magnetic, wind, railway and aerial engineers, and a number of others may spring up when we are taken away. An engineer is a man who is generally understood to be very active in attending to his engine and machinery, keeping it in good order and clean; do a few repairs himself; not a stationary man to look at some boy do the work. I would, therefore, propose that our society be called the "Canadian Engineers' Society," and open our doors to all engineers, and have among ourselves examining committees or boards for each branch of free lectures, with addresses and remarks which may be of much use and edification to us all. Union is strength, power and force. As all animal bodies are machines, men and women included, we should be all physical engineers of ourselves, and a benefit to our neighbors; we should study our own mechanism and see what can be done to prevent sickness, promote health and long life and a happy one; drop off all useless habits and regulate our diet and rest as we do the steam to the cylinders and in the boiler, by a good safety valve.

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*A paper read before the Manchester Association of Engineers.

When I look at the words "stationary engineers," for myself and position, I find that it does not well apply to me, as I have every day to overlook in the Toronto Asylum for the Insane, 50 closets, 25 bath-tubs, 30 wash basins, drains and ventilators, 6 water tanks (40,000 gallons), pipes and taps, about 300 working every day; 14 heating boilers—hot water system; 4 steam boilers, 2 for cooking; the baking of meat and everything by steam for 800 people in 14 kettles, and two others for laundry work (about 8,500 pieces are cleaned every week), with six washing machines, six mangles, and ironing machines, both steam and gas; 50 electric bells, 16 telephones, batteries, electric light and gas pipes, chandeliers, a blacksmith shop for doing all repairs about the house and farm, and burn 1,700 tons of coal per year. You cannot call me "stationary" when in addition to this I look after four hydraulic elevators and 2,240 feet of railroad with ten cars.

Mr. Trowern also read the following poem:

The Little Canadian Engineer's Birthday.

He has given up his cradle and his little worsted ball;
He has hidden all his dolls behind the door;
He must now have a rocking horse, and a spinning top of course,
For he isn't mamma's baby
Any more.

He has now cut off all his curls, for they're only fit for girls,
And left them in a heap upon the floor;
For he's five years old to-day, and laughs to hear his parents say,
He'll not be mamma's baby
Any more.

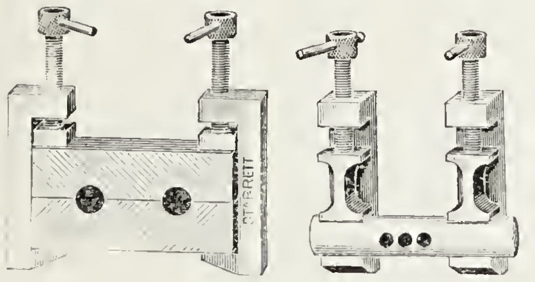
He has pockets in his pants like his older brother, Jack;
And he thinks he should have had them long before.
His boots are buttoned to the top; he jumps and will not stop,
Because he isn't mamma's baby
Any more.

He has heard his parents sigh, and has greatly wondered why,
They think he'll grow some day to be a man.
Now he's their darling little boy, then he'll be their pride and joy,
For he cannot be their baby
Any more.

When he's advanced in life and he thinks he'd love a wife,
His parents should direct him how to choose;
For he wants a happy home when his engine work is done;
And to be her darling boy
Ever more.

Yes, he'll find in her a mine, for she's worth her weight in gold;
She will save and make the best of everything.
She will read and play and sing, and he'll help the music ring;
He's her darling happy boy
Ever more.

TOOL MAKERS' STEEL CLAMPS.

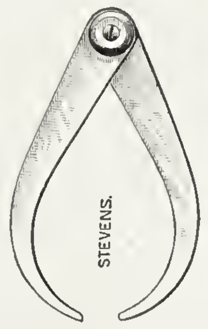


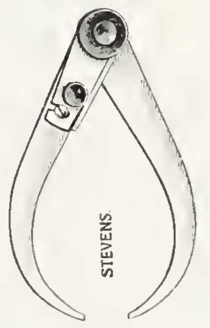
No. 160.

These clamps are made from drop forgings, nicely finished, case-hardened, and have take-up blocks to slip on and off end of screw, and are held to same in a novel manner. They will hold work square and parallel for laying out on surface plates, fitting or drilling, and the makers state that a round piece may be rigidly held in two of the clamps and drilled on an upright, central and parallel. They are put up and sold in pairs. With the small block in use, the capacity of the smaller clamp is a little over one inch, and that of the larger clamp two inches, and they are made only in two sizes, 1 inch and 2 inches, and a guarantee of their quality is the fact that they are made by the L. S. Starrett & Co., of Athol, Mass., and are put on the market by the Aikenhead Hardware Co., who report large sales and perfectly satisfied purchasers.

SHOP POINTERS.

In submitting "Shop Pointers and All-Steel Tools" to the mechanics of the country, the publishers, J. Stevens Arms & Tool Co., Chicopee Falls, Mass., fully realize the critical inspection to which it will be subjected. However, they invite inspection and criticism, for every tool they illustrated has the maker's approval and guarantee. They believe them to be mechanically perfect. The publishers solicit criticism and correspondence. If every mechanic into whose hands "Shop Pointers and All-Steel Tools" comes, will offer suggestions on tools, and give his ideas on using them, they will put this information into such form, they state, that they can give it to anyone who will write for it. A free interchange of ideas will help to make better mechanics; this means better wages. "All-Steel Tools," is our motto, to quote exactly. Whenever advisable, we harden our all-steel tools; in fact, no expense or care will be spared to keep our tools where they are now—at the front.





Man is fallible, and if through any oversight an imperfect tool should leave our factory, we will consider it a favor if the mechanic receiving it will return it to us, that we may make good the error. During the last year, where there has been chance for improvement, every tool and rifle manufactured by us has been remodeled; some have been discontinued. Everything now made by us is modern in every particular. We believe that our efforts in the course we are pursuing will be appreciated. We wish to work in closer sympathy with the mechanics, so they will feel there is one tool-making company that has their welfare in mind. This book is the only one from which tools should be ordered.

Chas. P. Fay, so well known as an inventor and designer of calipers, dividers and fine tools, has acquired the interest of his late father in the J. Stevens Arms & Tool Co., where he learned his trade and brought out his first calipers and dividers. The tool department is under his supervision. The Fay Ideal and Leader Calipers and Dividers are his latest patents in this line, while there are also ready, or in process of construction, several new tools which will fill long felt wants of mechanics. A few extracts from this little book, which will be sent free on receipt of a postcard to the publishers, are here given:

DEPRECIATION OF FIRST COST OF MACHINERY A YEAR.

	Depreciation.	Wear and Tear.	Total.
Engines	3 per cent.	3 per cent.	6 per cent.
Boilers	7 per cent.	3 per cent.	10 per cent.
Machines	5 per cent.	3 per cent.	8 per cent.
Gearing, etc....	3 per cent.	2½ per cent.	5½ per cent.
Bands & belts.		45 per cent.	45 per cent.

To Soften Cast Iron for Drilling.—Heat to a cherry-red, having it lie level in the fire. Then with tongs, put on a piece of brimstone, a little less in size than the hole is to be. This softens the iron entirely through. Let it lie in the fire until slightly cooled, when it is ready to drill.

To harden small tools or articles that are likely to warp in hardening, heat very carefully, and insert in a raw potato, then draw the temper as usual. A bar of hard soap is also good, but will not make the tool as hard as the potato will. In laying out work on planed surfaces of steel or iron use blue vitriol and water on the surface. This will copper-over the surface nicely, so that all lines will show plainly. If on oily surfaces, add a little oil of vitriol; this will eat the oil off and leave a nicely coppered surface.

RULES FOR CALCULATING SPEED.

The diameter of driven given to find its number of revolutions.

Rule.—Multiply the diameter of the driver by its number of revolutions and divide the product by the diameter of the driven. The quotient will be the number of revolutions of the driven.

The diameter and revolutions of the driver being given to find the diameter of the driven that shall make any number of revolutions.

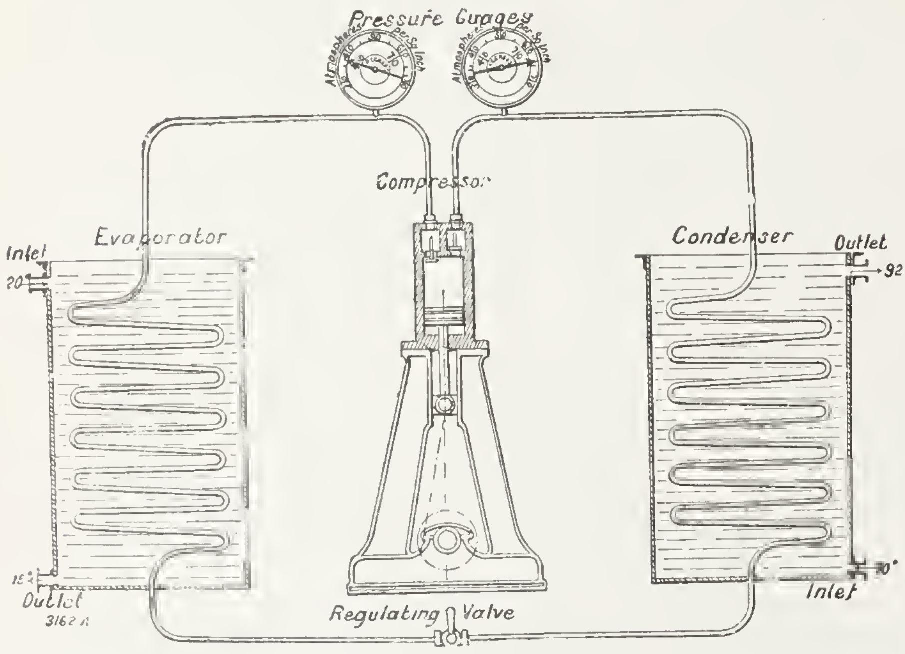
Rule.—Multiply the diameter of the driver by its number of revolutions and divide the product by the number of required revolutions of the driven. The quotient will be its diameter.

To ascertain the size of pulleys for given speeds.

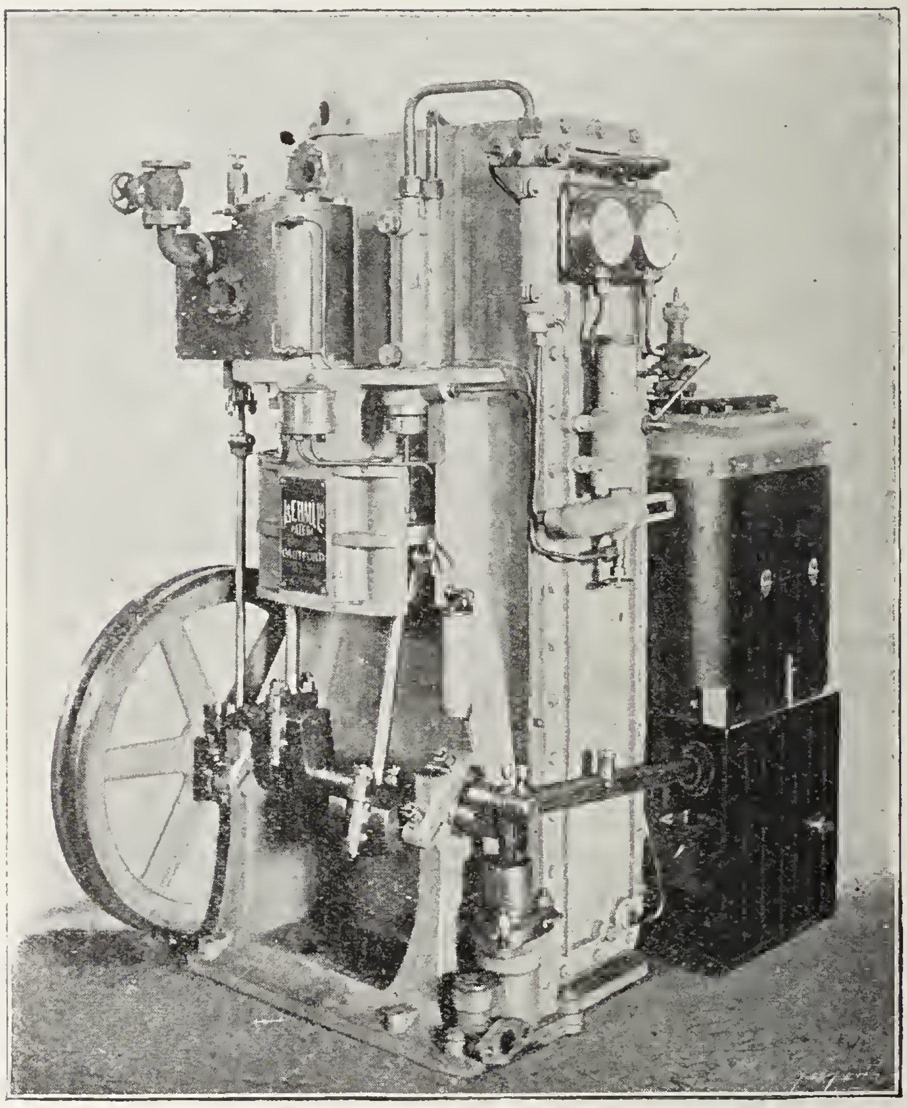
Rule.—Multiply all the diameters of the drivers together and all the diameters of driven together; divide the drivers by the driven. Multiply the answer by the known revolutions of main shaft.

REFRIGERATION.

The Carbonic Anhydride Refrigerating machines, made by J. and E. Hall under their patents, consist of the following three parts: 1. The compressor (the only moving part), in which the gas drawn from the evaporator is compressed. 2. The condenser, consisting of coils, in which the compressed warm gas is cooled and liquefied by the action of cooling water. 3. The evaporator, consisting of coils, in which the liquid carbonic anhydride evaporates, producing any degree of temperature that may be required down to 80 degrees below freezing point. The charge of carbonic anhydride originally put into the machine is used over and over again, going progressively through the processes of compression, condensation, and evaporation. Thus a small quantity only is required to be added from time to time to replace any small losses, and for this purpose Carbonic Anhydride is sent in steel cylinders to any part of the world. The cost of the material is only a few pence per pound. The quantity required for a complete charge is very small, the cost of a charge for a 24-ton ice plant being only about $35. Carbonic Anhydride is stated by the manufacturers to be a non-poisonous gas.



The compressors for the large machines are bored out of solid steel forgings, to secure strength and soundness of the material, and to provide a perfect bore in which may work the cup leathers with which the pistons are provided. Compressors of smaller machines are cast in a special bronze, which secures the two essentials of soundness and hardness. The gland is made gas-tight by means of two cupped leathers on the compressor-rod. Glycerine is forced into the space between these leathers at a pressure superior to the greatest pressure in the compressor, so that whatever leakage takes place at the gland is a leakage of glycerine either into the compressor or out into the atmosphere, and not a leakage of gas. What little leakage of glycerine takes place into the compressor is advantageous, inasmuch as it in the first place lubricates the compressor, and in the second place it fills up all clearances, thereby increasing the efficiency of the compressor. In order to replace the glycerine which leaks out of the glycerine lubricator, there is a small hand hydraulic pump, a few strokes of which are required to be made every four or five hours, as may be indicated by the position of the glycerine piston-rod.



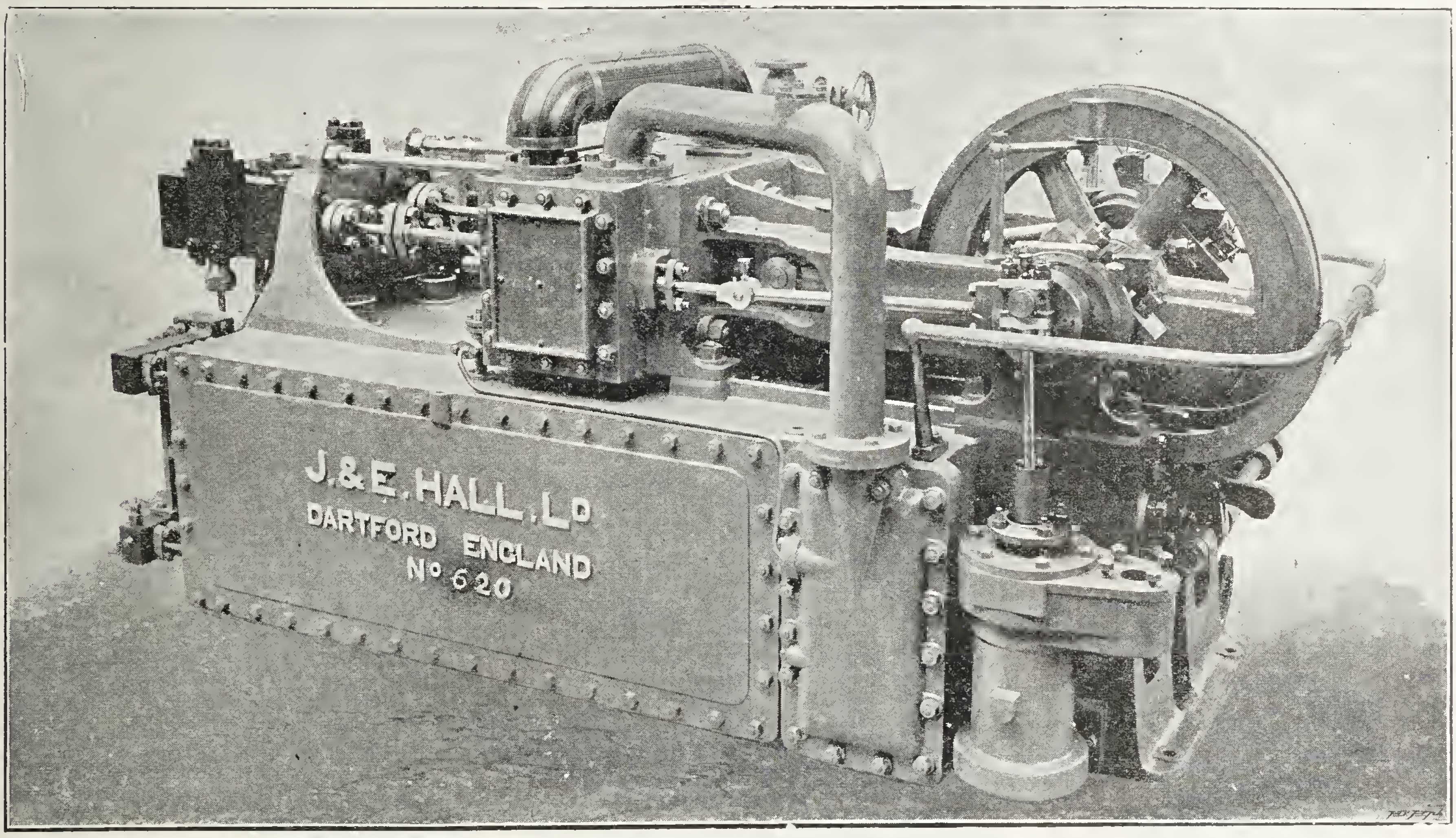
VERTICAL MARINE TYPE OF J. & E. HALL'S PATENT CARBONIC ANHYDRIDE REFRIGERATING MACHINES.

The condenser consists of coils of wrought-iron hydraulic pipe, usually of 13-16-in. bore, which are either placed in a tank and surrounded by water, or are arranged so that water trickles over them, forming the well-known atmospheric condenser. These coils are welded together into such length as to avoid altogether any joints inside the tank, where they would be inaccessible. The welding of these pipes is all done by the electrical method, which gives very reliable results. The condenser has, the makers state, one very important advantage of Carbonic Anhydride machines as is apparent, for as Carbonic Anhydride has no chemical action on copper, in the numerous cases where sea-water only is available for condensing purposes, that metal is used in the construction of the coils. The evaporator also consists of nests of wrought-iron hydraulic pipes welded up into long lengths, inside which the carbonic anhydride evaporates. The heat required for evaporation is usually obtained either from brine surrounding the pipes, as in cases where brine is used as the cooling medium, or else from air surrounding the pipes, as in cases where air is required to be cooled direct. Between the condenser and evaporator there is a regulating valve for adjusting the quantity of the liquid carbonic anhydride passing from the condenser.

As a refrigerating agent, liquefied carbonic acid is claimed to be second to none. Under atmospheric pressure it evaporates from the solid state at the particularly low temperature of 120 degs. F. below zero, or 152 degs. below the freezing point of water. In the refrigerating machine, however, it is caused to evaporate at only a few degrees below the temperature of the material which it is proposed to cool, the principle of the machine being exactly the same as that of machines using anhydrous ammonia on the compression system—viz., as water boils at 212 degs. F. under atmospheric pressure, and about 250 degs. F. at, say, 15 lbs. pressure, fire being usually the source of heat, so liquid carbonic acid boils at 30 degs. F.

at 35 atmospheres' pressure, and thus permits cold water to be the source from which the necessary heat to boil it is absorbed, exactly in the same manner as the heat of the fire is absorbed in boiling water. The compressor draws the gas from the evaporator and compresses it to the liquefying pressure, which is controlled within certain limits by the temperature of the cooling water. The heat due to compression is absorbed by the cooling water in the condenser, the gas circulating within the condenser coils and becoming liquefied by the time it reaches the lower extremity of these coils.

By regulating the pressure in the evaporator, the liquid is caused to boil throughout the coils of the evaporator, which act in the same manner as the heating surface in a steam boiler, and the temperature or boiling point of the liquid carbonic acid adjusts itself to that of the source of heat which is causing it to boil, whether it be water at 70 degs. to be reduced to 40 degs., or brine to be maintained at + 10 degs. F. or — 10 degs. F. The surfaces of the evaporator coils are so proportioned that all the liquid which enters at the lower end of the coil is evaporated by the time it reaches the top end, and thus the maximum efficiency is obtained. The compressor then draws in only gas, and compresses it up again to the pressure necessary to liquefy it, and delivers it warm to the condensing coils to continue the cycle of operation. These machines are extensively used on board ship, in cold storage warehouses, breweries, ice factories, etc., not only in Great Britain but throughout the British colonies and the world generally.



HORIZONTAL DUPLEX TYPE OF J. & E. HALL'S PATENT CARBONIC ANHYDRIDE REFRIGERATING MACHINES.

THE ASSOCIATION OF RAILWAY SUPERINTENDENTS OF BRIDGES AND BUILDINGS.

The eighth annual convention of the Association of Railway Superintendents of Bridges and Buildings was held at Richmond, Va., from October 18 to 20, 1898. The programme included many features of amusement and pleasure besides the reports of the various committees.

The committee on the subject, "Pile Rings and Method of Protecting Pile Heads in Driving," presented the following report: First. We find that the best way to protect the pile head is to use a 1x3-inch ring, made out of the best iron that can be obtained at the place where used. We recommend, where a railroad company have a steam hammer in its shops, that they make their pile rings out of hammered iron from old car axles. The cost of a 1x3—14-inch diameter ring is $1.75, while the same size ring made out of best bar iron costs $2. A pile ring made out of hammered iron will last to drive 75 oak piles and at least 300 cedar piles. The rings made out of best bar iron usually last to drive 50 oak piles and 200 cedar piles; in fact, one of your committee had 50 pile rings made out of old car axles four years ago, and since that time has driven 250 oak piles and 6,000 cedar piles without any renewal of pile rings. A pile driver should carry on the tool car 60 pile rings, 10 pile rings 15—30—14 inch., 10—13½ inch., and 10—13 inch. in diameter. The 14-inch diameter are the ones most used, 14-inch being the width of caps used by most roads. It is not necessary to have the pile head larger in diameter than the cap is wide.

Second. In fitting the pile ring, the pile should be neatly sawed off square; the pile should be neatly chamfered down at least 5 inches from the end, so the ring will just catch on and let the pile hammer do the rest. This is a little hard on rings, but in this way you are sure to get a good fit of the ring and the pile head is best protected.

The face of the pile hammer should be concaved to the depth of 1½ inches in the centre, and run out to nothing 2 inches from outside of the hammer; this will drive the fibre of the wood down slightly over the edge of the ring and make a neat fit of the hammer, and if the piles are kept exactly under the hammer, there is very little danger in fracturing the pile. The best weight of a pile hammer is 3,300 pounds. The height of the blow should not exceed 12 feet in driving cedar piles, or 20 feet in driving oak piles. It will be found that short, quick blows will drive the pile as quick as long blows, and are less liable to injure the pile. The pile should be neatly prepared before driving it; the knots should be neatly trimmed off, and the pile sharpened to a 4-inch square point for hard driving, the point to be made as near straight with the pile as possible. Piles should never be over-driven. When a pile does not go over 1 inch at a fall of 10 feet with a 3,300-pound hammer, the blow should be shortened to 6 feet, and the pile carefully driven until it stops going or does not go over ¼-inch at a blow. The driving of piles for railway traffic, and for all kinds of structures, requires a great amount of judgment to do good work.

The report of the Committee on the care of iron bridges after erection, including the best method of protecting them from salt water drippings from refrigerator cars, stated that the successful maintenance of a bridge will depend upon the character of the bridge to be maintained—a bridge which has been properly designed requiring less attention than one which has been bungled. By "less attention" it is not to be inferred that neglect is meant. If the bridge was first class in the first place, and by "first-class" is meant one which has been designed by an engineer thoroughly familiar with this class of work, the material of which is of the best quality obtainable, and an assurance of that quality being evidenced by tests and inspection, the shop work on which has been done in a shop thoroughly equipped to do good work and a competent inspector being present to see that this work is done, and finally one that has been erected without abuse, and left in perfect condition, without a loose nut or rivet and which after having been thoroughly cleaned of all dirt and loose scale, has been painted with at least three coats of the best paint obtainable, then the proper care of this bridge means merely to keep it in as good condition as it was the day it was put up. This seems simple enough on its face, but unfortunately those who have charge of the maintenance of the bridge are so relieved after they get possession of a first-class structure, that they turn their attention mainly to other bridges and are inclined to allow the new one to take care of itself without any special attention for a number of years. Even the inspector whose duty it is to go from bridge to bridge regularly passes over this new structure with the thought, "it was just put up a short time ago and there can be nothing the matter with it;" in fact the new bridges are too often almost neglected on account of the attention which must be given to those which are bad. The care of new plate girder bridges of modern design involves less actual labor than any other class of bridge work, but there are many plate girders which are of defective construction carrying trains to-day. Their webs may be ¼-inch thick, rolled in short lengths and spliced together by an insufficient number of rivets and not sufficiently stiffened against buckling. Their flanges may be composed of light flange angles to which are riveted heavy cover plates, and the transferring of the strain of the flange angles through the webs is done by rivets made ⅝-inch in diameter and spaced at such a distance apart as to subject them to the danger of shearing off. The care of such a bridge is a serious question, as there is no good way to strengthen it. It should be trestled and renewed as soon as possible. In the above but little has been said concerning the painting of a bridge. The kind of paint to be used is a matter which many engineers are not fully agreed upon, and has been a subject of discussion at previous meetings of this society. The committee therefore consider that they are not called upon to enter into this question further than to say that no matter what kind of paint is used, no matter what is paid for this paint, and no matter how well the paint is applied to the surface, if that surface has not been thoroughly cleaned of all rust, scale, dirt, and grease before the paint is applied, it will not give satisfaction. The question of best method of protecting bridges from injury by salt water drippings is one upon which little can be said. That this dripping is very injurious to metal none will question except perhaps the owners of refrigerator cars. Some little interest is being taken in this subject by the officials in charge of track and bridges, but little or none by those in charge of the transportation departments, and while the remedy should be applied to the cars instead of the bridges, there will undoubtedly be opposition to this method by the car owners, who will probably be very slow to provide their cars with the necessary protection unless forced to do so by the railroad companies' united action. Voluminous reports accompanied by diagrams were also presented on the cost and manner of putting in pipe culverts, on round house smoke jacks and ventilation on heat floors for shops and round houses.

LITERARY NOTES.

Soft Coal Burning is a most interesting discussion of the subject of boiler setting and construction, and the benefits of careful firing. The author is C. M. Higginson, and it has already reached its fifth edition. There are twenty pages of closely printed matter, all of which is of value to the steam producer.

Mechanical Draft for Steam Boilers, by Walter B. Snow, being an abstract of a lecture before Sibley College, Cornell University, has been reprinted from The Sibley Journal of Engineering, and we have been favored by the author with a copy. We will return to the subject at a later date when we can devote more space to it.

We have received the Engineers' Year Book, published by the Society of Engineers of the University of Minnesota, which comprises about one hundred pages and contains a number of instructive articles, among which one of the most instructive is that of the Reclamation of Wet Land, by W. R. Hoag, C.E.

Printers' Ink, New York, has gotten out a 70 page pamphlet neatly bound in rough green paper, which sets forth the great merits of this famous advertising weekly. The outside cover bears in red letters the statement: "American advertising is the best in the whole world, and Printers' Ink made it what it is."

The Whiting Foundry Equipment Co., Hainey, Ill., U.S., has sent us a copy of the second edition of their general catalogue. The firm also issues special catalogues of cranes, cupolas, air hoists, Avery holding machines, etc.

We have on our table a copy of Shop Pointers and "All-Steel" Tools, which is a neat and comprehensive catalogue, published by the J. Stevens Arms & Tool Co., Chicopee Falls, Mass., U.S.

The Ores of Nova Scotia, by E. Gilpin, jr., is a description of the gold, lead and copper deposits of Nova Scotia; it has not been written from a technical or scientific point of view, but intended to convey in a practical manner a fair idea of their extent, value and adaptability for profitable mining. The lead and copper deposits of Nova Scotia are as yet undeveloped, although they are wide spread and promising. The gold deposits, alluring from their display of free gold, have received locally much attention. This attention, as may be gathered from his brief remarks, has not been for many years of an encouraging nature, as it was an affection of the hope of immediate returns, and not an endeavor to reduce gold mining to its true position, a commercial enterprise. Until a few years ago the local capitalist wanted something rich, a fortune without labor, extracted from a golden bunch of quartz or from the pocket of an innocent investor. Now, however, the fact is recognized that gold mining is a business, not necessarily a roseate speculation; and veins and deposits are being profitably worked, on business principles, which, a few years ago, would have been spurned. Since this principle has been accepted it is safe to say that the gold interests of the Province, Mr. Gilpin states, have an assured future.

A copy of the Entropy-Temperature Analysis of Steam Engine Efficiencies, with a blank diagram arranged for easy application to any concrete case, prepared by Sidney E. Reeve, M.E., adjunct professor of steam engineering at the Worcester Polytechnic Institute, has reached us. The original discoverer of the entropy method to steam engine analysis was Prof. Willard Gibbs, of Yale University. Since then many engineers of prominence have subscribed to and used the method. The immediate progenitor of this present form of diagram was a similar one projected by Professor Boulvin, of Ghent University, a description of which will be found in Engineering (London) for January 3, 1896. This diagram not appearing to the author to be either convenient or exact for general use, it was modified by him to the form herein offered to the profession for adoption or criticism. The nomenclature and notation is in accordance with Professor Ewing's "Steam Engine and Other Heat Engines."

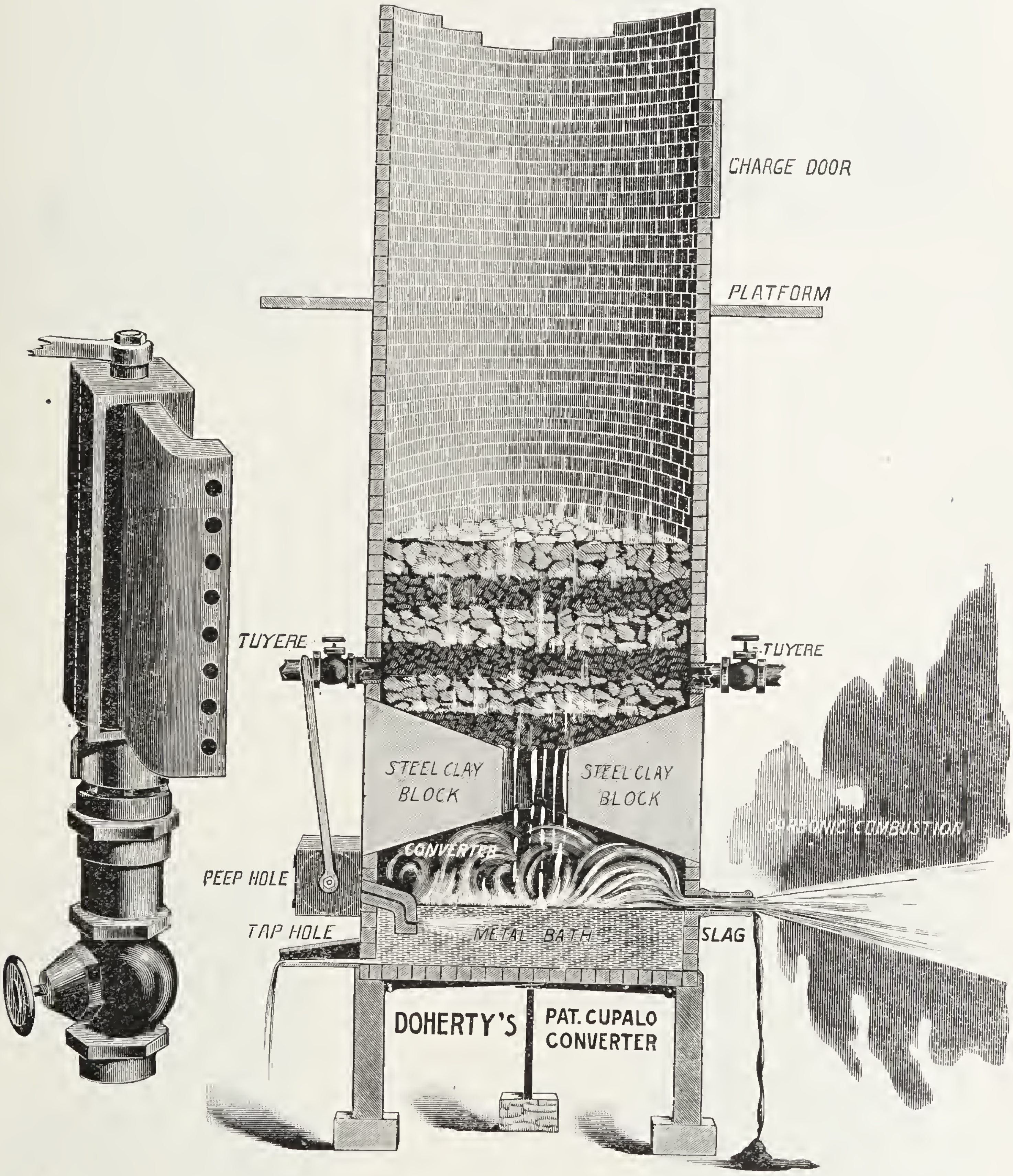
The Practical Tool Maker and Designer is a treatise upon the designing of tools and fixtures for machine tools and metal working machinery. It comprises modern examples of machines with fundamental designs for tools for the actual production of the work; together with special reference to a set of tools for machining the various parts of a bicycle. The author is Herbert S. Wilson, M.E. There are 189 illustrations, and the publishers are Henry Carey Baird & Co., Philadelphia.

The Department of Colonization and Mines of the Province of Quebec has issued a special report by J. Obalski, mining engineer for the government, on the gold deposits of the province. It is entitled, "Or dans la Province de Quebec, Canada," and comprises some hundred pages of valuable statistics and general information.

W. A. Morehouse & Co., publishers of The Sherbrooke Examiner, deserve great credit for the artistic style in which they have produced "Sherbrooke Illustrated," a handsomely illustrated history and description of the enterprising capital of the Eastern Townships. The book contains over 100 pages, and more than that number of half-tone engravings of the public buildings, colleges, schools, churches and other institutions of the city, with portraits of leading citizens and samples of the picturesque scenery of the Magog river, which gives to Sherbrooke so much of its beauty as well as its great commercial advantages in water power.

A DEPARTURE IN FOUNDRY PRACTICE.

This recent invention of Thos. Doherty, Sarnia, Ont., consists essentially of a cupola and pneumatic converter combined in one. An ordinary cupola is divided by refractory fire bricks so arranged as to form a double bottom or partition above where the pig and scrap iron is charged in the usual manner, as shown in cut. The metal, as it becomes melted, falls down through an opening into the converter chamber where it accumulates and forms what is known as a bath, upon which compressed air is applied, and it is claimed by the inventor, converts the molten metal into any quality of steel desired, by the operation of a valve in the blast pipe. The reaction produced is similar to that of all the other pneumatic processes and produces intense heat, burning out the silicon and carbon and carrying off the slag automatically through the opening at the side as shown. In other words the raw material is charged in above, melted, converted into steel and tapped out below by one operation. This process is more especially adapted to making steel machinery castings at a low price. The difficulty heretofore, in the general adoption of steel castings, has been the extra cost. The process is being generally patented on this continent and in Europe.



A Departure in Foundry Practice.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The first meeting of this society for the winter season was held at the society's rooms, Montreal, on Thursday evening, 13th October, P. W. St. George in the chair. There was a very large attendance, and the fortnightly meetings give promise of being very interesting.

After routine matters had been disposed of the secretary announced that a book had been opened in which to record the names of members seeking employment, it being the desire of members generally to assist those temporarily out of employment by giving them information of firms who might need their services. Several applications for membership in the society were recorded.

The following donations to the library were received: "Modern Methods of Sewage Disposal," from C. A. Biggar; "Surveying Instruments" and "Mathematical Drawing Instruments," from W. Ford Stanley; Report of the Hydraulic Engineer of Queensland on the Queensland Water Supply for 1897, from J. B. Henderson; "American Cements," from Uriah Cummings, of Akron, Ohio; "Centrifugal Pumps, Turbines and Water Motors," from E. J. Boswell; photographs and pictures from J. W. Heckman, and a box containing about 100 volumes from John Kennedy.

The paper of the evening was by Prof. John T. Nicholson, of McGill University, on "Riveted Joints," which was not concluded, but is to be taken up again at the next meeting.

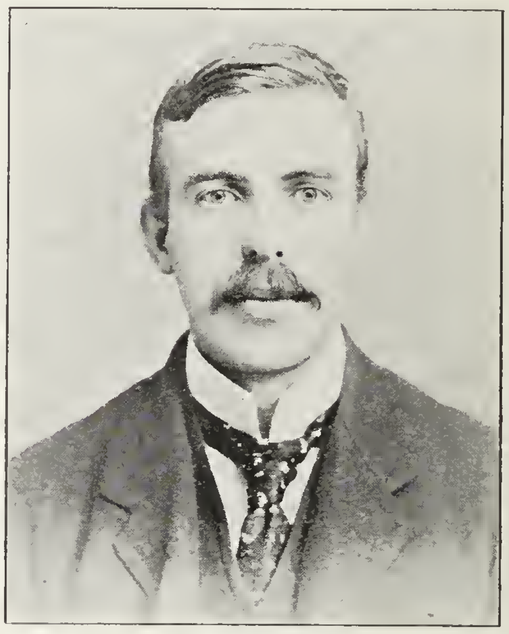
DR. JAMES WALLACE WALKER.

Dr. James Wallace Walker, M.A., Ph.D., the professor chosen for the new McDonald chair of organic chemistry in McGill University, Montreal, comes to McGill with a most brilliant record from the greatest teaching universities in England and on the continent of Europe. Prof. Walker is strongly recommended by Dr. Welhelm Ostwald, Ph. D., professor of Physical Chemistry in the University of Leipsic, one of the greatest of the world's great chemists. Dr. Walker was educated at the University of St. Andrews, Scotland, taking M.A. in 1889, as was stated in last issue of The Canadian Engineer, and after a short time spent in teaching mathematics at St. Andrews, he was appointed lecture assistant in chemistry at that university. In 1892 he entered the University of Leipsic and was shortly afterwards elected to one of the 1851 Exhibition Scholarships, holding it for three years, and received the degree of Ph. D. in 1896. In 1896 he was appointed lecturer in organic chemistry under Professor Ramsay, in University College, London, and was in 1897 also appointed examiner in chemistry for the Arts, Science and Medical degrees at the University of St. Andrews.

R. B. OWENS, E.E.

R. B. Owens, E. E., who has just been appointed to the W. C. McDonald professorship Electric Engineering at McGill University, is a native of Maryland, U. S., where his family has lived for generations, and where its members have held high positions of public trust. He was educated in Johns-Hopkins and Columbia Universities, obtaining the degree of E.E. at the latter. Prof. Owens resigned the charge of the Electrical and Steam Engineering Departments of Nebraska University to accept his present position at McGill. Among his most recent successes is the planning of the new engineering building for Nebraska University, which has been opened this month. At the Columbian Exhibition in Chicago Prof. Owens was a member of the jury in the department of electricity and chairman of the Electrical Committee, and as we stated in last issue of The Canadian Engineer was director of the Bureaus of Electricity and Machinery at the Trans-Mississippi Exposition at Omaha. He is a member of the Western Society of Engineers, the American Society of Mechanical Engineers, and the Council of the Society for the Promotion of Engineering Education, and vice-president of the American Institute of electrical engineers.

ERNEST RUTHERFORD, B.A., M.A., B.SC., OF TRINITY COLLEGE, CAMBRIDGE.



Ernest Rutherford, B.A., M.A., B. Sc., the professor of physics in McGill University, comes from Trinity College, Cambridge, and brings with him eulogistic testimonials from the faculty there, including a flattering recommendation from Dr. J. J. Thomson, M.A., Sc.D., F.R.S., professor of physics in Cambridge University. Prof. Rutherford, although already eminent in his profession, is a young man, having taken his first degree of Bachelor of Arts in the University of New Zealand in 1892, as we stated somewhat more fully in the October number of The Canadian Engineer, when we mentioned a few of the subjects in which Mr. Rutherford has made special research. He was made Master of Arts in the next year and Bachelor of Science in the year following at the same university. Coming to England he entered Trinity College, Cambridge, where he obtained the degree of Bachelor of Arts.

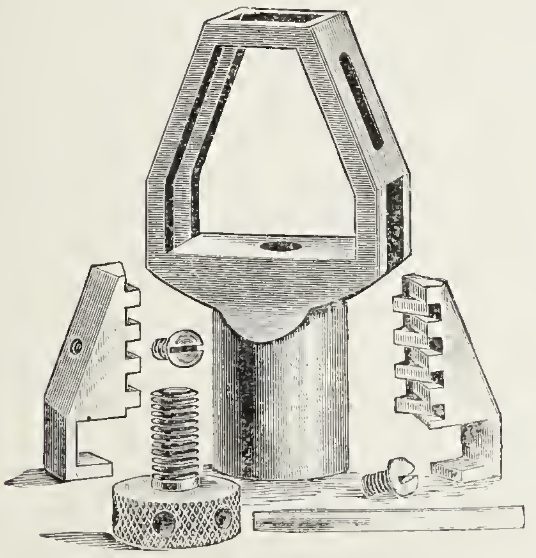
E. G. COKER, B Sc E

E. G. Coker was born in 1869, in Wolverton, and in 1883 entered the engineering shops of the London & Northwestern Ry., England, as a pupil, and served two years in the fitting, turning erecting and pattern makers' shops, and afterwards spent two years in the drawing office engaged in the design of railway plant and machinery. In 1887 he entered as a student of engineering at the Royal College of Science, London, spending three years in the various laboratories of the college, passing out with a first-class associateship in mathematics and engineering. During period of training at Royal College of Science he gained the senior Whitworth exhibition for the year 1889, and in the next year the second Whitworth scholarship for proficiency in engineering science, these scholarships being open to all British subjects. After a short period in the works Mr. Coker entered the civil engineering course at Edinburgh University, being principally engaged in research work, passing out with the degree of Bachelor of Science in Engineering. After a year spent in engineering work he entered Peterhouse, Cambridge, and became a candidate for the Engineering Tripos, in both parts of which he was placed in first class, with special distinction being awarded in the subjects of "Theory of Structures and Strength of Materials" and "Heat Engines and Dynamics of Machines," being the only candidate who has up to now obtained these distinctions. During college vacations he spent the summer months in various works gaining experience in testing materials, constructive work and the like. Mr. Coker was elected (1895) a scholar of Peterhouse, and recently (1897) elected a member of the Institute of Mechanical Engineers. He has written papers on "The Tensional Strength of Solid and Hollow Shafting," and "On the Endurance of Steel Bars Subjected to Repetitions of Tensional Stress," published in the Proceedings of the Institute of Civil Engineers. He has devoted much attention to the design of instruments for measuring tensional strains, the results of which were embodied in a paper read before the Bristol meeting of the British Association in September last. Mr. Coker has just resigned the post of assistant examiner of patents in Her Majesty's patent office, London, to take up the duties of assistant professor of Civil Engineering at McGill.

FIRES OF THE MONTH.

Oct. 9th. Ott's tannery, Brantford, Ont.; loss on building, $2,000; contents, $1,000.——Oct. 13th. A small fire occurred in the Guelph, Ont., Linseed Oil Works.——Oct. 15th. Woodworking factory of Jos. Gosselin, Levis, Que.; loss about $25,000.——Oct. 17th. The Canada Eastern Railway Co.'s round house at Gibson, N. B.; six locomotives were destroyed.——Oct. 19th. The Canadian Pacific Railway round house at Teeswater, Ont.; one locomotive was destroyed.——Oct. 26th. A. Thiboulot's carriage shop, Levis, Que.; loss about $15,000.——Oct. 26th. W. H. Tighe's evaporator, Chatham, Ont.; remaining building destroyed; loss $1,000.——Oct. 26th. The Royal City Planing Mill Co.'s mill known as Hastings mill, Vancouver, B.C., burned, with damages $200,000, and $83,000 insurance.

THE NATIONAL DRILL CHUCK.



The following claims for the National Drill Chuck are made: 1. That the grip to hold a drill is unequaled by any chuck upon the market. 2. The construction is so simple that any person can put it together in one minute. 3. The simplicity of construction and arrangement of parts causes the least wear, making it the most durable. 4. It is the only chuck ever made that all parts are exposed to view, so that any irregularity can be seen at once. 5. It can be thoroughly cleaned in one-fourth the time of any other chuck. 6. All unnecessary material is removed, leaving the strength where required, and making it from one-third to one-half lighter than any other chuck made. 7. The only chuck that is easily cleaned, being so open that the dirt will not stay in, and can be blown or brushed out without removing the parts. 8. A chuck that is perfectly balanced and made in all sizes—large and small. 9. The only chuck that is strong and powerful, equally adapted for either light, swift or heavy work. 10. The only chuck made that is adapted for heavy work having tapering body, with jaws projecting, so when using small drills, it will not cast a shadow or interfere in seeing your work. 11. The only chuck made that by being perfectly balanced, and small at lower end, will do the work of two other chucks, thereby saving the expense of one. 12. The easiest chuck to repair, the least liable to get out of order, making it the cheapest to buy. 13. The only chuck made with an unfinished body for blacksmithing and carriage work, making it stronger, cheaper and equally effective for use. The National Drill Chuck is made with finished and unfinished bodies, the inside workings of both being the same. The body of the finished is polished, while that of the unfinished is left with a black, smooth surface as forged. It is made in seven sizes in capacities ranging from 0 to 2 inch. Further information can be obtained from Aikenhead Hardware Co., Toronto.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interes to the metal trades from Great Britain during September and the nine months ending September, 1897, 1898 :—

	Month of September.		Nine months ending September.	
	1897.	1898.	1897.	1898.
Hardware	£7,041	£3,453	£50,672	£20,003
Cutlery	..	3,847	..	40,251
Pig iron	1,240	273	5,298	8,405
Bar, etc.	977	741	7,572	8,300
Railroad	171	2,147	38,893	25,154
Hoops, sheets, etc.	13,792	8,169	55 954	44,811
Galvanized sheets	7,346	4,445	35,547	44,252
Tin plates	30,073	5,667	132 840	104,039
Cast, wrought, etc., iron	3,887	4,041	25,957	24,457
Old (for re-manufacture)	1,937	..	5,191	3,754
Steel	6,258	4,282	41,061	39,734
Lead	5,170	4,339	19,062	24,665
Tin, unwrought	2,403	537	13,814	13,680
Alkali	5,808	4,210	26,082	32,035
Cement	3,757	2,934	15,611	17,927

WHO INTRODUCED THE EXPANSION CYLINDERS.

Editor CANADIAN ENGINEER.

Sir,—Touching the discussion that has been going on in The Scientific American and American Machinist as to who was the inventor of the second and third expansion cylinders in steam engines, Robt. W. Rule, Aylmer, Ont., adds a valuable statement. He says that in 1848 he was called out at St. John, N.B., to repair a boat called the "Reindeer," which ran between St. John and Fredericton. This steamer was fitted with a second expansion cylinder of the Wolff patent. Mr. Rule is a trustworthy machinist, and his statements could easily be verified at St. John. The old gentleman has many reminiscences of the famous Boulton & Watt "Soho" works near Birmingham, England, where he served his apprenticeship, 1840-6.

B.

CORRECTION.

In presenting in our last issue a synopsis of the paper "Remarks on the Systems of Refuse Disposal in Various European Cities," read by Thos. Macfarlane, chief analyst for the Dominion Government, before the American Public Health Association, a typographical error was made in describing the system in use in Bremen, Germany, which is that of using "Moss-Litter" as a deodorizer. This is also used in a hotel at Caledonia Springs, Ont., which Mr. Macfarlane mentions.

Industrial Notes.

J. H. Allan, Milton, Ont., is to establish a creamery in Carleton Place, Ont.

The St. Thomas, Ont., Brass Company has equipped a foundry at a cost of $10,000.

Lindsay, Ont., is lending $20,000 to Sylvester Bros., foundrymen, to extend their business.

Clark Bros., Toronto, have the contract for building the Normal School, London, Ont.

An iron bridge has been erected at Glendale, C. B., by R. Musgrave & Son, North Sydney.

The Geo. White & Sons Co., Ltd., London, Ont., is building a new boiler shop, 70x70 feet.

The Guelph Paving Co. will get a contract from Brockville, Ont., for about $60,000 of pavement.

The capital of the Page Wire Fence Co., of Ontario, Ltd., has been increased from $40,000 to $100,000.

Ker & Harcourt, spool and bobbin manufacturers, have removed their plant from Walkerton to Parry Sound, Ont.

Wm. Willoughby, brick and tile manufacturer, Carleton Place, Ont., is closing up business, and will dispose of his plant.

It is proposed to establish a match factory in Winnipeg, for which the city council is asked to give a bonus of $15,000.

Krug Bros. & Co., Chesley, Ont., have ordered an 80 h.p. boiler and engine from the Robb Engineering Co., Amherst, N.S.

Brantford, Ont., has granted the Chalcraft Screw Co. and the Nott Bicycle Company exemption from taxation for ten years.

Willis Chipman, C. E., has reported that necessary improvements to the Sherbrooke, Que., waterworks will cost about $62,000.

Arthur Hilyard and Jules Spiro, New York, are negotiating with people in St. John, N. B., for the erection of a pulp mill at Navy Island.

Waterloo, Ont., will submit a bylaw to be voted on Nov. 21st to raise $50,000 for the purchase of the waterworks and to complete the system.

Bannerman & Findlater, boiler makers, Ottawa, have just shipped two 80 h.p. boilers to the mills of McLaurin & McLaren at East Templeton, Que.

H. Sewrey, G. H. Sewrey and W. Johnson are building a foundry in Barrie, Ont. It will be a one-story frame building, 120 feet long and 36 feet wide.

Thurso, Que., has decided to have a waterworks system. The Stadacona Power Co., Montreal, has the contract for installing it. The price is $14,000.

The Guelph, Ont., Linseed Oil Co. is now in operation and is producing raw and boiled oil from Canadian flax seed. Fourteen men are employed at present.

The town of Dundas, Ont., is applying to the Legislature for power to grant to John Bertram & Sons, the famous machine tool builders, a bonus of $12,000.

Berlin, Ont., took possession of the waterworks on Oct. 8th, which have hitherto been operated by a company. The price paid by the town was $102,000.

E. G. Barrow, city engineer, Hamilton, Ont., proposes a new 30-inch main from the Beach pumping station to the city at a cost of between $161,152 and $181,815.

H. McLean, of Calgary, in company with Wanless & Carsons, has purchased the Calgary flouring mill, from the Manitoba Grain Co., and will refit it with new machinery.

The Granby, Que., Iron Works, owned by G. F. Payne, and comprising foundry, iron works and machine shops, have been disposed of to S. S. Dabble, Sandy Hill, N.Y.

The new drill-shed at Kingston, Ont., will be of stone, 230 by 115 feet, and will be erected in the old Artillery Park. Work will be begun on it at once. The cost will be $15,000.

W. G. Nott, J. T. Ham and J. H. Ham, M. A. Nott and C. W. Hoffmann, Brantford, Ont., have received an Ontario charter as The W. G. Nott Bicycle Company of Brantford, Ltd.

The statement of the affairs of the British Columbia Iron Works, Vancouver, B.C., published this month, shows losses of $126,000; the creditors have agreed to accept 50 cents on the dollar.

The Toronto Terra Cotta Co.'s works on the C.P.R., near Milton, Ont., which have been closed for some years, are being put into working order and will resume operations shortly on a large scale.

Tenders are called for a steel arch bridge at the Gorge, Victoria Arm, B.C., by the chief commissioner of lands and works, British Columbia, and will be received up to the 30th of this month.

The Paris Electro-Plating Co., Paris Station, Ont., has been compelled by growing business to build a moulding shop, 32x50 feet, and the company is now prepared to turn out fine gray iron castings.

The recent disastrous fires in Levis, Que., have opened the eyes of the town corporation to the necessity of a proper waterworks system, and at its last meeting it decided to construct one and have it in working order by Oct. 1, 1899.

City Engineer Barrow, of Hamilton, Ont., is collecting information as to the amount of garbage requiring destruction in the incinerator which the city health department is about to build by day labor.

W. H. Frost, proprietor of the Smith's Falls, Ont., Malleable Iron Works, is asking the town for a $10,000 bonus on condition of the works being so extended as to employ 50 more men. Freedom from taxation is also asked.

The ratepayers of Fort William, Ont., have been notified that the bylaw under which they proposed to borrow $35,000 for waterworks is of no effect, as more than a year has passed since the bylaw was carried. Another will be submitted.

R. A. Waite, architect, Buffalo, U.S., has been refused admission as a member by the Association of Architects of the Province of Quebec on the ground that the provisions of the constitution of the association did not permit of it.

The Truro, N. S., Headlight states that the Londonderry Iron Co. has sold the pipe plant and machine shop plant, at Acadia Mines, N. S., to the People's Heat and Light Co., of Halifax, and that it will be removed to that place this winter.

A large saw mill is being erected at Lake Temiscouta, Que., by James Miller, of St. John, and D. A. Huntley, of Parrsboro. The mill, which is to begin operations next spring, will have a capacity of about 15,000,000 feet of lumber during the summer season.

R. Gray, J. S. Gray, M. Daniels, J. McEwen and M. Campbell, Chatham, Ont., are applying for incorporation as The Wm. Gray & Sons Company, Ltd., to manufacture all kinds of vehicles including bicycles. Chief place of business, Chatham, Ont.; capital, $150,000.

C. B. Frost, F. T. Frost, M.P., C. H. Frost, Maria E. Frost, and Caroline L. Frost, Smith Falls, have applied for incorporation as The Frost & Wood Co., Ltd., to carry on the machinery manufacturing business of Frost & Wood, Smith's Falls; capital, $800,000.

The Maritime Sulphite Fibre Company, Chatham, N. B., has ordered a 500 h.p. cross compound condensing engine from the Robb Engineering Company, Amherst, N. S., to replace their present 250 h.p. simple engine, and to provide for contemplated enlargements of their plant.

The cold storage building going up in London, Ont., at a cost of $40,000, is being built by Henry Lucas, Toronto, who has the contract for the brickwork and masonry. Hilliard & McKinley, London, will do the carpentering, and the iron work was awarded to the London Foundry Company.

Following is a copy of a letter sent from the Globe File Mnfg. Co., Port Hope, Ont., to the Dodge Mnfg. Co., Toronto, dated, Oct. 3rd, 1898: "We are reminded by your Mr. Hass that we have not told you how we like the last rope drive. We may say immense. We put it up as per your plans, started it to run and it went off so well we have only adjusted one pulley since. You may refer persons to us when talking rope drives. We would not return to gears again for four times what the four drives cost us. We feel you have used us well, we wish you made the ropes too, as we have faith in your ability."

The evidence in the arbitration for the ex-appropriation of the Campbelltown, N.B., waterworks is finished, and the Court adjourned until November 16th, when the argument will be heard. Willis Chipman, civil engineer for the town, values the plant at $51,000, and Jas. Laurin, civil engineer for the company, at $123,180.

The Model gas and gasolene engine which is being manufactured and placed on the market with great success by the Goldie, McCulloch Co., of Galt, Ont., is a very light running, economical and useful engine, and is especially adapted for small installations.

Price Bros., Quebec, have bought ground at Batiscan, Que., for the erection of a saw mill, to which will be transferred their present business at St. Stanislas. The mill will be equipped with the latest modern improvements, lighted by electricity, and with a capacity of 200,000 logs per season.

The contract for laying a 10-inch main for the municipality of Verdun, Que., has been awarded to Matthew Dineen, contractor, Montreal. The Three Rivers Iron Works Co. is to supply the cast iron pipes and specials. Work was commenced on the 10th inst., under superintendence of McConnell & Marion, civil engineers, Montreal.

C. A. Birge, manager of the Canada Screw Company, Hamilton, Ont., states that he knows nothing concerning the probable sale of the works in this city, beyond the fact that the directors of the company have been empowered by the shareholders to make such disposition of the property as may be to the best interests of those concerned.

The Diamond Glass Company, Hamilton, Ont., which bought out the Toronto Glass Works about two years ago and transferred the blue-glass works from Hamilton, will remove also the flint-glass works, better known as the Burlington Glass Works, to Toronto, where exemption of taxation for its works has been secured for ten years from Jan. 1st next.

The Terra Nova Boiler and Engine Works, Ltd., St. John's, Nfld., has been formed, of which Hon. E. R. Bowring is president; Hon. A. W. Harvey, vice-president, and J. Anderson, secretary, with a board of directors consisting of Hon. J. Baird, J. Browning, W. B. Grieve, W. C. Job. The old business in Hoylestown has been taken over and will be greatly enlarged.

The St. John, N. B., Sun and other New Brunswick papers are discussing with a great deal of vigor the fact that various bridge contracts have been let without being advertised in the daily papers, and that changes have been made in the plans after the contracts were awarded, which materially cheapened the work. The Sun charges that in some cases those changes amounted to 50 per cent of the cost of the work.

The bylaw to make a loan of $30,000 to the Wm. Hamilton Mnfg. Co. has been carried by the ratepayers of Peterborough, Ont. The company will put up a new building 100 feet wide by 350 feet long, and 60 feet to the peak of the roof, paralleling the G. T. R track. A switch from the G. T. R. line would be laid through the building. The company is to pay 3½ per cent. for the loan, and to repay it, principal and interest, in 20 years.

The Lachine, Que., town council intends to take up the question of town drainage in a serious manner this coming winter. This question has been agitated for years, but in view of the large increase in population it presses for solution. The difficulty in the way seems to be a place or means of disposal, as it is impossible for Lachine to follow the filthy custom of the continent and pour its sewage into the river, to pollute the water supply of Montreal.

The E. B. Eddy Co., of Hull, have just installed what is probably the largest paper machine in Canada. The frame of the machine is 153 feet long, and it has thirty 120-inch driers. It is provided with ring oilers and the cylinders are cast hollow in one piece by a patent process. The bottom calendar roll weighs 1,585 lbs. The machine is driven by a 250 h p. engine, and is capable of producing 20 tons per day of news, manilla or wrapping paper.

J. G. Pennycuick, F. W. Barrett, J. O. Buchanan, E. W. Cox and F. Wyld, Toronto, Ont., are being incorporated as The Pennycuick Glass and Light Corporation of Toronto, Ltd., to manufacture prisms, prismatic-glass, prismatic-globes, glass-conduits for electric wires, glass-tiles for wall decoration, and all products and articles relating to and necessary for the transmission and distribution of natural or artificial light; capital, $40,000; chief place of business, Toronto.

The electric motor carriages being built by the Canadian Motor Syndicate with the Still system of storage batteries are proving very successful. The carriages weigh, with batteries complete, only 750 lbs., and on a recent test the carriage ascended the steepest hills in Toronto, with the roads in a very unfavorable state, there being a great deal of mud. One of the leading business firms of Toronto has ordered a delivery van equipped with the Still batteries.

Since the advertisement was published calling tenders for the construction of the Quebec bridge, numerous applications have been received for information upon which to base tenders. Some of these come from England, France, Belgium, Canada and the United States. As it will cost contractors a large sum to make up a tender and the exhaustive plans that will require to accompany it, the number of actual tenderers is likely to fall very short of the number of those seeking present information.

The Syracuse Smelting Works, which recently opened a branch in Montreal for the manufacture of solder and babbit metals, have been so successful in extending their Canadian output, that it has been necessary to add another furnace to the works, making three now running. Business continues to be brisk and the company has just made a shipment of two cars of babbit metal and solder to Halifax, and two cars to St. John, N. B. They report their trade increasing all through Canada and prospects very bright.

Up to Sept. 1st last, the Detroit Lubricator Co., of Detroit, Mich., had manufactured and sold 400,000 Detroit Sight Feed Lubricators, and it is continuing at the rate of from 5,000 to 7,000 per month. Lubricator No. 400,000 went to South Africa, while lubricator No. 399,000, made about a week earlier, went to Java. Wherever there are steam engines, or any other kind of engines for that matter, the Detroit lubricators are in evidence, preventing friction, saving fuel, and making the lives of the engineers, as well as the machinery, run along more easily.

An important judgment was recently given by Judge Morgan, Toronto. Over a year ago the Canada Illuminating Company sold the Victor Light, which the Auer Light Co. claimed was an infringement on their patents. The Auer Light Co. started proceedings, and the judgment was given in a test case in favor of the Auer Light Co., holding that the Victor light was an infringement, and ordering damages at $2 per light. His Honor also ordered that the brasswork be delivered to the plaintiffs.

F. W. Eddy, West Newton, Mass., has bought land in Margaree Harbor, Cape Breton, where he will erect a large saw mill. The mill will have a 30 h.p. engine and boiler, rotary mill, shingle machine and a stave machine, consisting of a cylinder saw, heading rounder and stave joinder. The machinery, which is being supplied by the Robb Engineering Co., Amherst, N.S., will be on the ground and fitted up by the middle of November. This will be, it is said, the most completely equipped saw mill in Cape Breton.

The annual inspection trip of the directors of the Canada Iron Furnace Company, the Radnor Water Company and the Shawenegan Water & Power Company, was recently made the occasion of a pleasant excursion to what is rapidly becoming one of the industrial centres of Canada. Among the party were: Hon. Mr. Marchand, Premier of Quebec; P. H. Griffin, president of the Canada Iron Furnace Company; J. G. Smith, A. F. Gault, T. J. Drummond, W. J. White, E. L. Pease, Dr. W. H. Drummond, J. N. Greenshields, Alex. Pringle, Montreal, and Melville Aldred, S. Bagley, Capt. Piorkowski, of the German army, representative of the famous Krupp gun makers.

There was a large gathering of Ottawa Valley lumbermen recently at the W. C. Edwards' & Co., Ltd., mills, Ottawa, to see the test of the process for conversion of sawdust into commercial products. Prof. Ruttan, McGill University, Montreal, was also present. The visitors were shown through the building where the machinery is, and saw at one part wet sawdust being carried into the machine proper, coming out in tarry oils, pyroligneous acid, carbon and gas. The machine gets its fuel from the gas obtained from the sawdust. Another process for the treatment of sawdust, and the production of calcium carbide and the tarry oils, pyroligneous acid, etc., is being patented.

The Penberthy Injector Co., Detroit, has won its suit against the Lee-Penberthy Manufacturing Co., restraining the latter company from using the name Penberthy on its goods. Wm. Penberthy, whose patents were bought by the Penberthy Co., and improved by it, insisted upon his name appearing on the injectors. When he withdrew from the company and organized the Lee-Penberthy Co., he used his name on the injectors made by the new company. As the name had become well-known as describing the apparatus of the first company it was claimed as a trade mark of the first company and has so been allowed by the Court.

The Sarnia Salt Company, Ltd., of which Wm. Lord Moore, Chicago, is president, and W. J. Hume, Sarnia, secretary, has applied for permission to increase its capital stock from $20,000 to $100,000. The works of the company have been idle for some time, but it is intended to resume operations on a large scale. This development of the Canadian salt wells is not improbably connected with the prohibition of the export of Canadian logs to Michigan, says The Sarnia Despatch. The Michigan salt wells use the refuse from the lumber mills as fuel, and when that is cut off the cost of operating them will be greatly increased, thus affording a material advantage to the Canadian wells.

The Rossland Air Supply Co., Ltd., has been incorporated in British Columbia, with a capital stock of $200,000, and having for its subscribers C. K. Milbourne, Nelson, manager of the Dominion Mining, Development and Agency Company, and of the Cascade Water Power and Light Company; A. J. McMillan, Rossland; D. J. Fitzgerald, Trail; W. S. Norman, Rossland and Spokane, and F. Aug. Heinze, Butte, U.S. The company will develop water powers by the use of compressed air under what is known as the Taylor hydraulic air compression system, which has been fully described in former issues of The Canadian Engineer. The 14-inch air main from the place of development to Rossland will cost in the neighborhood of $130,000.

An important change has been made in the course of lectures on "Steam and the Steam Engine" at the Toronto Technical School. This consists of dividing the subject into two parts, so that as well as the lectures on "the theory of heat engines or thermodynamics" others will be given of a practical nature, dealing with "the indicator, valves and valve motions, efficiency of engines and boilers, gas engines," etc. Harris Elliott, B. A. Sc., who has charge of this course, has had considerable experience in the actual design and construction of engines, and it is hoped that in this way it can be made interesting to mechanics and others who are not qualified to take the theoretical work. The practical lectures commenced Oct. 21st, at 8.30, with a discussion of "the indicator and how to use it."

The Ontario Government has concluded an agreement with an English syndicate by which E. A. Bremner, London, Eng., has secured from the Government the right to cut spruce timber on a reserve along the Sturgeon river.. The tract consists of 75 square miles of spruce lands. The company engages to spend a million dollars in buildings and plant, and will have an operating capital of two and a half millions. The pulp mill was formally opened at Sturgeon Falls, Oct. 1st, and the foundation of the first of six paper mills has been laid. The company undertakes to employ not less than 240 hands. The output will be 120 tons per day. The terms of the contract with the Government provide that all spruce cut must be manufactured in Ontario. Wm. G. Finlay, Lawrence, Mass., who has had eighteen years' experience, has been engaged as working manager.

Fetherstonhaugh & Co., patent solicitors, of Toronto and Montreal, furnish the following list of patents relating to machinery or engineering, granted to Canadians in the following countries. Any further information may be readily obtained from them direct: Canadian Patents.—Tanning machinery: J. H. Smith; automatic car-couplers, P. Hoff and E. Francis; belt shippers, C. Dawson; wire tightening device, O. Johnson; spring-cable, tension device, T. S. Witman; valves, F. Roy; frame saws, L. Long; hollow spring wire cable, J. Morlock; automatic switches, F. W. Ross; rock crusher and pulverizer, R. B. Seabrock; machine for weaving wire fence, J. Rocheleau; method of extracting precious metals from pulverized rock or sand, J. F. Latimer; machine for washing gold, E. L. Tetrean and W. M. Ogden; apparatus for separating ores, minerals, etc., W. T. Newman; trolley bases, H. G. Taylor. American Patents.—Apparatus for mining in frozen ground, S. H. and E. B. Haycock; chemical engine, T. Down; mechanism for imparting successive or alternating movements, E. Moore.

J. A. Simmons and the International Sanitary Gas Company, West Virginia, have begun suit in the United States Court against L. G. Harris, Toronto, to enforce a contract which they claim he refuses to carry out. Harris is the patentee of a method of making gas from garbage. It is alleged in the complaint that he agreed to sell to Simmons, or to a company which he was to form, all the patents he had obtained or might obtain, for the sum of $500,000. He was to receive $1,000 on the signing of the contract, and $5,000, $24,000, $25,000, $25,000 and $200,000 in one, two, four, five and six months from that date, the balance to be paid within a year. It was further agreed that when the company was formed all of the capital stock was to be turned over to Harris as security, and he was to deposit it with the Manhattan Trust Company. In case of default of the payments, Harris had the right to break the agreement. The company was formed and the agreement was signed on April 27, 1898. and since that time it is alleged that Harris has been paid $10,000. When a tender of the stock was made he refused to accept it, claiming that the contract was void. The claimants ask that the Court issue an order compelling him to carry out the terms of the contract and restraining him from disposing of the patents.

Electric Flashes.

Hull, Que., is having estimates prepared for a municipal lighting plant.

The Rogers Electric Co., London, Ont., is establishing a branch in Toronto.

Edward A. Evans succeeds F. H. Badger as manager of the Montmorency Electric Light and Power Co.

C. Snell and Tremaine have bought the electric lighting plant from the Exeter Electric Light Co.

The Cataract Power Co. began to supply power for incandescent lighting to Hamilton, Ont., Oct. 23rd.

The C.P.R., Montreal, has purchased a two-phase induction motor from the Canadian General Electric Company.

The Canadian General Electric Company has sold an electric plant to the Oxford Mnfg. Co., Oxford, N. S.

The Hamilton, Ont., Radial Electric Railway Co. will extend its line from Burlington, Ont., to Port Nelson.

Munderloh & Co., Montreal, have purchased a 200 light dynamo from the Canadian General Electric Company.

At a recent meeting of those chiefly interested in the Cornwall Street Railway several extensions and improvements were decided upon.

Jos. S. Craig has been appointed electrician to the Toronto Fire Department in place of Electrician Gibson, who has resigned from illness.

Glace Bay, Cape Breton, is to be lighted by electricity. Over 800 lights have been already subscribed for, and the plant will be installed this fall.

The Lachine Rapids Hydraulic Land and Power Co. has placed another order with the Canadian General Electric Co. for a three-phase induction motor.

Whitby, Ont., has sat in darkness recently, owing to a disagreement between the town council and the local lighting Company as to the renewal of a contract.

The British Columbia Sugar Refinery Co., Vancouver, B.C., has purchased from the Canadian General Electric Company one of its new type 25 k.w. multipolar generators.

W. C. McDonald, Montreal, whose generous gifts to McGill University have caused him to be held in honor all over the Dominion, has made an additional donation of $35,000, to be spent on the Department of Electricity in raising it to the same standard of completeness as the other departments.

James Donaldson, Bayfield, Ont., has disposed of his electric light plant and saw mill to N. M. Contine, St. Joseph, Ont.

Bradford, Ont., has accepted the tender of the Johnston Electric Co., Toronto, of $1,900, for installing and equipping an electric light plant.

The T. Eaton Co., Toronto, has ordered a 50 h.p. automatic engine for direct connection to dynamo, from the Robb Engineering Company.

Port Perry, Ont., council has granted Dr. Mallow the right of erecting telephone poles on certain streets so as to connect with Prince Albert, Ont.

J. Robinson & Co., Winnipeg, Man., have purchased a 10 h.p. slow speed 500 volt multipolar motor from the Canadian General Electric Company.

Jos. Graham, sawmill owner, Grand Valley, Ont., is burning his mill refuse to generate electricity to light the town of Arthur, Ont., ten miles away.

The Ottawa Street Railway Company will install a large storage battery plant to compensate for the fluctuation in power caused by anchor ice in winter.

W. B. Lanigan has retired from the Board of Directors of the Galt, Preston and Hespeler Street Railway. J. W. Leonard, superintendent of the C.P.R., succeeds him.

The London Electric Company has just placed an order with the Canadian General Electric Company for two standard No. 12 125 light multi-circuit Brush arc dynamos.

The Gulline Pneumatic Collar Co.. Granby, Que., is putting in a large electro-plating apparatus, building an addition to the factory, and increasing the size of the steam plant.

W. Miller, Esq., Glen Miller, Ont., is installing a new electric plant for his paper mills, and has purchased a 150 light machine from the Canadian General Electric Company.

J. C. Wilson & Co., Lachute, Que., have purchased from the Canadian General Electric Company for the lighting of their premises, a standard 17½ k.w. multipolar generator.

The Petrolia Topic thinks that the proposed electric railway from Sarnia to Petrolia would be a big benefit to the tunnel town, but Petrolia would be deprived of considerable trade.

G. H. Harper, R. T. Wilson, J. J. Grafton, E. B. Harper and John Bertram, Dundas, Ont., have been incorporated as The Dundas Electric Company, Ltd., with a capital of $40,000.

G. T. Simpson, electrical manufacturer, Hamilton, Ont.. was recently acquitted of a charge of unlawfully obtaining electrical energy from the Electrical Power and Manufacturing Co., Ltd., Hamilton.

James Barry of Niagara Falls, Ont., John Ross and John McRae have been given a contract for work amounting to $300,000 on the development of electrical power at Shawenegan Falls on the St. Maurice.

The C. O. Dell Electric Company, Annapolis, N. S., is doubling the capacity of its plant. E. Leonard & Sons have shipped them a large Leonard-Ball automatic engine, 120 h.p., from St. John, N. B.

Some of the influential citizens of Ste. Genevieve and Point Claire, Que., are considering the uniting of the two parishes by an electric road, having for its object enlarged facilities for communication with Montreal.

A movement is on foot in Ridgetown, Ont., to have an electric railway built between that town, Thamesville, Morpeth and Rondeau Park. Robt. Ferguson, M.P., and W. E. Gundy, are among those chiefly interested.

Prof. Rutherford, McGill University, delivered a most interesting lecture with a practical demonstration, on "The electrical transmission of messages without wires," before the Applied Science Society of McGill, recently.

J. A. Jamieson, superintendent C.P.R. elevators, St. John, N.B., has given an order to the Canadian General Electric Co. for a 30 k.w. generator, together with all the wiring material required to complete the installation.

R. McCallum, C.E., of the Public Works Department of Ontario, has inspected the power works of the Keewatin Power Co. for the Government. Alex. McQuarrie has been appointed manager of the works at Rat Portage, Ont.

Application for incorporation will be made to next session of the Ontario Legislature on behalf of the Toronto Elevated Railway Co., which wishes to build elevated and surface railways in Toronto and adjoining municipalities.

The town council of Port Arthur, Ont., has made an arrangement for an electrical and water supply from the Jenison power canal, at Kakabeka Falls, which was described briefly in our last issue. The contract has to be submitted to the electors.

The directors of the Victoria Industrial School, Mimico, Ont., have decided to install an electric plant for the lighting of the various buildings, and to carry out this work have purchased a 300 light plant from the Canadian General Electric Company.

L. Paquette, a workman employed at a building in the course of construction in Montreal, met his death a short time ago in a peculiar manner. He was working on a derrick, and the boom touching an electric wire formed a circuit through his body. Death was instantaneous.

The Canadian General Electric Company has just received an order from Wm. Cook, St. Catharines, for a standard 60 k.w. single-phase alternator. It is Mr. Cook's intention to undertake the furnishing of light to private consumers in connection with his present power plant.

The Hull Electric Company, Ottawa, is increasing its generating plant, and have purchased from the Canadian General Electric Co., a standard monocyclic generator, having a capacity of 150 k.w., with marble panel switchboard and instruments complete. This makes the third machine of this size type which this company has purchased.

The Department of Electrical Engineering, McGill University, Montreal, is adding to its electrical equipment a number of special generators, motors, transformers and testing instruments to be used in connection with the experimental work. An order has been placed for these requirements with the Canadian General Electric Company.

A Piers, superintendent of the C.P.R. Co.'s steamship lines, has placed an order with the Canadian General Electric Company for a direct driven unit to be installed on the steamer Alberta. This consists of a 25 k.w. generator, direct connected to a 9x10 "Ideal" engine. The order includes a marble panel with standard instruments and wiring.

H. Cargill & Son, Cargill, Ont., have decided to install an up-to-date electric plant for their requirements to furnish light and power to their residences, mills, barns and warehouses, and for this purpose have purchased a 500 light plant from the Canadian General Electric Company, together with several motors for operating machinery and elevators.

L. Becigneul et Cie, Lake Megantic, Que., are installing an incandescent electric system for the town, and for that purpose have purchased from the Canadian General Electric Company a standard 30 k.w. single-phase generator with marble panel switchboard complete. They have also placed an order with the same company for all transformers and wiring supplies required to carry out the work.

The corporation of Campbellford, Ont., has recently passed a bylaw for the purpose of remodeling and increasing its electric plant, and to carry out the work, has purchased from the Canadian General Electric Company a standard 120 k.w. single-phase alternator complete, together with all the transformers and wiring material required to carry out the work. It is expected that this will be one of the most modern plants in Canada when completed.

R. B. Owens, the new professor in charge of the electrical department of McGill University, is introducing a new feature which will be of great value not only to the students but will also confer great benefit upon the general public. This is the standardizing laboratory. There will be a room devoted to high potential machinery where a voltage of 200,000 will be obtainable. The old shafting in the electrical department is all being taken down and each machine will be driven by a separate motor. There will be machines of the various types—single-phase, two-phase, three-phase, and synchronous motors. New types of high tension transformers and alternating current machinery are being installed. Prof. Owens has been given practically a free hand in reconstructing the laboratories.

The Canadian General Electric Company has received an order from the T. Eaton Company, Toronto, for a 25 k.w. direct connected generator with marble switchboard. This makes the fifth unit which the T. Eaton Company has purchased from the Canadian General Electric Company, the entire establishment being lighted and operated from these installations.

Howes & Leighton, Harriston, Ont., has decided to comply with the request of the merchants of that place to provide incandescent lighting for commercial and residential purposes, as well as arc lighting, which they are now furnishing, and for this purpose have placed an order with the Canadian General Electric Company for one of its new type 30 k.w. single-phase alternators, with marble panel, instruments and all the transformers and wiring required for the installation.

The People's Telephone Company, of New York, was incorporated Oct. 12th with a capital stock of $5,000,000, to operate a telephone system in New York city and in other cities, towns and villages in New York and other States, and in the Dominion of Canada. The capital stock is divided into $2,000,000 preferred and $3,000,000 common stock. The directors are: S. B. Dutcher, J. E. Nichols, E. S. A. Deluna, Francis C. Travers, Frank Brainard, J. Fred Ackerman and Darwin R. James, New York.

The Metropolitan Electric Company, Ottawa, which was given a charter by the city council, recently, is applying for a charter of incorporation, with a capital of $500,000. James Robinson, F. Cains, Montreal; A. Broderick, T. Lindsay and W. Arnold, Ottawa, are the directors. It is stated that the company has bought the immense water power on the Ottawa river at Britannia, just above the city of Ottawa, from J. R. Booth for $20,000.

At the annual meeting of the Standard Light & Power Co., Montreal, the following directors were elected: W. McLea Walbank, president; J. H. Burland, vice-president; Peter Lyall, W. S. Evans, F. Dagenais, M. P. Davis. The company is now installing two large motors recently bought from a firm in Cleveland, Ohio. These will be operated from the Lachine rapids, holding the steam plant in reserve. It was decided to ask for tenders for rotary converters and fire-proof the Chenierville street power station.

Within another year Quebec, it is said, will be one of the best lighted cities in the world. It will have no less than three companies converting water powers in its vicinity into electricity. They will be the present Montmorency Falls Company, the Chaudiere Company, now in course of formation, and the Jacques Cartier Water Power Company, which has already commenced to build at the falls of the Jacques Cartier river in Valcartier, some 18 miles from the city of Quebec. This company will, it is said, build large pulp and paper mills at the falls.

Barrie, Ont., is determined to have cheap electric light, and will establish a plant of its own, unless the existing company sells out to the town at the town's valuation. Now the council cannot raise money for the new plant without issuing bonds. To issue bonds requires the consent of the county council. The county council holds $10,000 stock in the light company as security for the deficit of an absent county treasurer, and naturally does not see the reasonableness of aiding a competitor starting in business.

H. D. Symmes, St. Catharines, Ont., has secured the contract from the corporation of Merritton for street lighting with 20 arc lamps. Mr. Symmes has also decided to undertake the operation of a commercial lighting plant, and for his requirements for this purpose has purchased from the Canadian General Electric Company one of their 1,000 light, standard, single-phase alternators. He proposes operating a street lighting service from the alternating system, using 2,000 c.p. enclosed alternating arc lamps. These lamps he has also purchased from the Canadian General Electric Company.

Mining Matters.

Gold mining is being undertaken in Pontiac county, Que.

It is proposed to put in a smelter at the copper mine at Lower Wentworth, N. S.

Deseronto, Ont., is importing iron ore from Marquette, Mich.

W. Ogilvie, the new administrator of the Yukon, arrived safely at Dawson City, Oct. 5th.

There seems to be quite a revival of gold mining on a profitable scale in the Chaudiere Valley, Quebec.

A twelve-drill electric compressor for the Iron Mask has been ordered and is expected to be in operation in the course of a few weeks.

Gold and silver bearing quartz are reported from Chipewyan as being found on many of the islands in Great Slave lake.

The new machine plant in the Deer Park mine, Rossland, B.C., is working admirably, and Superintendent Mulholland is much pleased with it. The shaft is now down about 280 feet.

A report from Asbestos, Que., states that the asbestos company there is turning out several tons of asbestos per day. A new vein has been discovered, and is pronounced the richest yet.

Mica of a quality that has not been equalled so far, is reported from a point 200 miles north of Kamloops, B.C. The deposits are said to be 40 to 80 feet in thickness and great extent.

Reports from Cape Breton state that an immense deposit of magnetic iron was lately discovered there, running in width to 1,000 feet, and two miles long. Several shafts are now sunk across the lead 200 feet apart.

The first motors to be installed in British Columbia for the purpose were started up by the West Kootenay Power and Light Co., Ltd., at the works of the B.C. Bullion Co., Silica, about three miles from Rossland, B.C., Oct. 16th.

It is said that before summer comes again, the weekly ore shipments of Rossland, B.C., will reach the 10,000 ton mark. This result can easily be attained by shipping ore that is already in sight on the Centre Star, Columbia-Kootenay, No. 1, Monte Cristo, Deer Park, Virginia, and the Velvet.

Charles W. Willimott, of the Geological Survey of Canada, has recently been exploring for molybdenite. He found large deposits near Desert, in Ottawa county, and in Pontiac and Ross. He advises Canadian owners to retain what molybdenite bearing lands they may have.

It is reported from St. John's, Nfld., that the Montreal syndicate that have been boring on the west coast have found oil in the three wells which have been sunk, and the quality is said to be first-class. The Newfoundland iron mines have sold this year 86,000 tons of ore to Germany, while the coming year Germany will, it is said, take 160,000 tons.

J. Harvey is now operating in Manitoulin Island, with one of Fraser & Harvey's rigs and a crew of men, drilling for a firm of American prospectors. Their contract calls for ten wells, to be sunk from 500 to 800 feet each, according to the "show" they get. Oil and gas in small quantities have been stated to exist for some time, and an effort will be made to develop them on a commercial basis.

The double compartment shaft on the Iron Horse mine, Rossland, B.C., has now reached a depth of 34 feet, and two sets of timbers have been installed. The ground for the seven drill compressor has been selected. The intention is to use coal for fuel, and in order to save the haulage the plant is located alongside the railway track, so that the coal can be delivered direct to the furnace from the cars.

A gentleman representing a large English smelting firm has been in Canada for some time lately endeavoring to secure a shipment of iron ore from a Canadian mine in order to test the properties of the Canadian article. He made a proposition to several owners that they should let him have 500 tons at a certain figure, on the condition that if the ore turned out to be satisfactory, his firm would purchase anywhere from 100,000 to 200,000 tons per annum. He expected the owners of undeveloped iron properties in Canada would be only too glad to have their ores tested in this way. He found, however, that none of them were willing to let him have the 500 tons without receiving a cash payment of more than the ore was worth and a great deal more than it could be obtained for in the United States, where he finally went for his ore samples.

H. W. Treat, New York, secretary of the Van Anda Mining Company, stated a short time ago that their properties on Texada island were improving daily in development. They have reached 200-foot level by a double compartment shaft, and at 180 feet the ore body has widened out to 20 feet; seven feet of this went $50 to the ton, and the other 13 feet $12 per ton, and is splendid concentrating ore. At the 200-foot level it opens up a magnificent body of copper glance, four feet of which is 25 per cent. copper. He states that a complete smelting plant is there ready for erection with the exception of the boilers.

W. A. Parks, lecturer in Toronto University, the geologist who accompanied the Niven survey party into Northern Ontario this last summer to extend the boundary line between Nipissing and Algoma, has returned in advance of the surveyors, to his duties in the university. Two years ago the Niven boundary line was run for a distance of 120 miles, terminating just north of Night Hawk lake. This season the work was resumed at the latter point, with the expectation of extending the survey to the Moose river, and thence connecting with Moose river. When Mr. Parks left the party the line had been extended for about 120 miles from Night Hawk lake to a point 16 miles east of the Abittibi river.

Rich gold fields have been discovered at Lake Atlin, in British Columbia, and the district is east of the summit of the Coast Range. Promising placers and good quartz have been found in the neighborhood of Lorne Creek and in the Skeena Valley, also east of the summit of the Coast Range. A gentleman, who spent the summer on the upper waters of the Lillooet, says, in The Victoria Colonist, that gold is distributed everywhere. He does not claim to have made any great discovery, but says that quartz veins are many and all of them carry gold. What there is in them can only be determined by development work. Such work as is in progress is full of encouragement. The existence of gold bearing country at these points along the eastern slope of the Coast Range suggests that what may be called a secondary gold belt extends along this whole region, which is about 800 miles in length.

Railway Matters.

The Canadian Pacific Railway Company is improving its elevator facilities at Port Arthur, Ont., by adding an extensive drying plant.

C. M. Hays, general manager of the Grand Trunk Railway, has ordered the construction of 200 additional flat cars for the system from Portland to Chicago.

The Collins' Bay Towing and Rafting Co., Kingston, Ont., have taken the contract to remove the wreck from the scene of the late Cornwall railway bridge disaster.

Mrs. F. Walker, Brooklin, has begun an action against the Ottawa, Arnprior and Parry Sound Railway for $10,000 damages for the loss of her late husband in a collision in May last.

The pople of Amherst, N.S., are promoting a railway from that town to North Port on the Northumberland Straits, about twenty miles, affording an outlet to an extensive coal and lumber country.

The lake steamer Empress of India was put into the dry dock at Picton and cut up into three. Her length will be increased by 45 feet, which will make her 227 feet long, and other improvements made.

The Lake Erie & Detroit River Railway will make another application to the towns and villages along the route for bonuses to aid in the extension of the line from Ridgetown to St. Thomas, Ont.

The contract for the construction of about thirty-five bridges between Montreal and Vaudreuil on the Montreal & Ottawa Short Line, which the C.P.R. Co. intend double tracking, has been secured by J. W. Munro, of Pembroke.

The Canadian Pacific has issued a circular, giving the hauling power of every locomotive on the line, and also what each one will carry, on every point in the division. By this new scheme, a trainmaster can see at a glance how many tons to put behind an engine.

Thos Power, contractor, has just finished the work on three bridges on the Drummond County Railway. The first in two spans over the St. Francis, 400 feet long and 36 feet high; the second over the west branch of the Nicolet, 140 feet long and 42 feet high, and the third at Petit Dechene, Moose Park, 100 feet long, and 32 feet high.

The Dominion Government railways system has awarded contracts for the construction of 300 box cars and 100 flat cars for use on the Intercolonial Railway. The Crossen Car Manufacturing Company, Cobourg, Ont., will furnish 100 box cars; the Rathbun Company of Deseronto, 50 box cars, and a Nova Scotia company the remainder.

The United States Supreme Court has decided that the Joint Traffic Railway Association is an illegal body. This judgment will have far-reaching effects. The association, of which the Grand Trunk and C.P.R. were members, was formed in 1895, its object being to establish and maintain reasonable and just rates, fares, rules and regulations on state and interstate traffic.

Hugh D. Lumsden, C.E., who has been in charge of the survey which the Canadian Pacific have been making from near Toronto to a few miles east of Sudbury, has returned. Mr. Lumsden reports that the survey is about complete and that a good line has been secured, starting from Clineberg, on the old Toronto Grey & Bruce, to a point four miles east of Sudbury, a total distance of 247 miles.

The Restigouche & Western Railway is making good progress under Engineer C. L. B. Miles. The first sod was turned Aug. 12 and ten miles of road were completed by Nov. 1.

The new shops of the Quebec Central Railway to be erected at Newington, Que., are to be operated by electric motors, the current being supplied by the Gas & Water Co., Sherbrooke, Que.

Application will be made to the Ontario Legislature for an Act to incorporate the Haliburton, Whitney & Mattawa Railway, to construct a railway from a point at or near the present terminus of the Grand Trunk Railway at Haliburton, to a point on the Ottawa, Arnprior & Parry Sound Railway, at Whitney, Ont., and in a northerly direction to Mattawa on the Ottawa river.

Important changes have taken place recently in the Intercolonial Railway. The position of general superintendent has been created and the office will be filled by Jas. E. Price, with headquarters at Moncton, N.B. The position of district superintendent, vacated by Mr. Price, will be taken by G. M. Jarvis, with headquarters at Truro, N. S. H. Fleming, late district train despatcher at Moncton, has been appointed chief train despatcher, with headquarters also at Moncton.

Surveys are being made for the proposed Ottawa, Bancroft and Irondale Railway, which is to connect the Ottawa, Arnprior and Parry Sound Railway at Carp, Ont., with the C.P.R. at Almonte, and thence southwest through the iron regions of Lanark and Hastings counties to the G.T.R. at Bancroft.

It appears probable that a railway into the Cariboo country in British Columbia will be built, the line running from the C.P.R., near Ashcroft, to Barkerville.

Considerable progress is being made with the construction of the Baie des Chaleurs railway, and with the preparations to make the port of Paspebiac an ocean terminus. At present the railway is within about three miles of Paspebiac, where the construction of a large pier to stretch out a hundred feet from the bar is being vigorously pushed. It will accommodate vessels of the largest tonnage and have at low water a depth of 36 feet. It will, it is expected, be completed by December, when the railway will also reach Paspebiac.

The Canadian Pacific Railway Co. has under consideration a proposition from interested parties for the construction of the Napierville Junction Railway. This company was incorporated in 1878 by an Act of the Legislature, with power to build a railway from a point in the parish of St. Remi to a point in Napierville with the privilege of extending its line in the county of St. Johns. Between 7 and 8 miles of the road have been constructed. A bonus of $2,500 has been voted by the municipality of St. Edward, $10,000 by the municipality of Napierville, and a subsidy of $3,200 per mile by the Federal Government, and as much by the Local Government.

Although the Government officials who examined the wreck of the railway bridge at Cornwall, Ont., have been very reticent about the matter, it is the general impression that the cause of the disaster was established to be the defective foundation of the piers. Warned by the disaster at the United States end of the Cornwall bridge, the chief engineer of railways and canals has decided to have the foundations of the piers at the Canadian end of the bridge tested by boring. This will determine whether the concrete has properly set under water, and whether the river bottom on which it rests is sufficiently solid to make the foundation of the piers secure.

Regarding the renewal of bridges the semi-annual report of the Grand Trunk Railway says: The president reported to the proprietors, at the last general meeting, that in addition to the reconstruction of the Victoria bridge at Montreal, it had been deemed necessary to the more efficient and economical conduct of the traffic to authorize the renewal during the next two or three years of the bridges on the section of the line between Montreal and Portland, and it has also been determined to renew certain bridges on the southern division used jointly by the Wabash Company. The proportion of the expenditure for reconstruction of the Victoria bridge properly chargeable to revenue has been fixed at £110,000, which together with the cost of renewing the bridges between Montreal and Portland, and on the southern division, it is proposed to charge to revenue account, spread over a period of at least five years, so as to obviate any undue increase in the maintenance charges in any one year. The reconstruction of the Victoria Jubilee Bridge has progressed satisfactorily, and it is expected that the new double track will be available for traffic by the 1st January next. Meanwhile the traffic is being conducted over the single track as heretofore.

The semi-annual report of the directors of the Grand Trunk Railway Company, which was presented at the half-yearly meeting in London, Oct. 13th, showed: Gross receipts for 1898, £1,871,733, as against £1,756,566 for 1897; working expenses were, 1898, £1,243,833; 1897, £1,196,643; leaving a gross profit of £627,850 for 1898, as against £559,923 for 1897. Receipts from subsidiary companies raised the net revenue to £730,672 for the 1898 half-year, compared with £654,395 in 1897. The net revenue charges for the half-year were £624,020, leaving a surplus of £106,651. The directors recommend the payment of the full half-year's dividend on the 4 per cent. guaranteed stock, which will absorb £104,395 17s. 6d., leaving a balance of £2,271 3s. 11d. The result of the past half-year's operations show an improvement of £103,943 5s. 9d. The comparative table of receipts for the half-years ending 30th June, 1898, and 1897, represents for 1898 a decrease of £25,656 in passenger receipts, and an increase for mails and express of £1,752, for freight and live stock of £99,270, and for miscellaneous of £115,168. The net increase is £115,168. The statements show that the Grand Trunk gross receipts for the half year show an increase of £115,168, or 6.56 per cent.; the working expenses, including taxes, an increase of £47,240, or 3.95, and the train mileage an increase of 430,171, or 5.17 per cent.

Marine News.

A dry dock to cost $1,000,000 is talked of at St. John, N.B.

The Montreal & Cornwall Navigation Co. have purchased the steamer Filgate.

The Steamship Pharsalia Co., Ltd., has received a New Brunswick charter; capital, $200,000.

The Government has awarded a contract for a new steel steamer for the P. E. Island service, to a Dundee, Scotland firm.

Clifford Lewis will build another steamer for the Lake of the Woods-Rainy River line. The craft is to be somewhat larger than the Edna Brydges, to carry about forty cabin passengers.

General Manager Gildersleeve, of the Richelieu & Ontario Navigation Co., recently stated that the history of the company during the season beat the record for freedom from accident. No boat had to be retired from active service, and not a single mishap occurred to a passenger.

Lyman J. Rogers, superintendent of the marine railway, Yarmouth, N.S., met with a serious accident by being crushed under a schooner, which was being hauled out for repairs recently.

The most important alteration contemplated by the Richelieu & Ontario Navigation Company in the matter of repairs to steamers will be for the placing of four new boilers in the Quebec.

The Richelieu & Ontario Navigation Company proposes to extend its Lake Ontario service from Toronto next season. The daily steamers between Toronto and Montreal will call at Charlotte, on the American side, both up and down.

Three seventeen knot steamships have been purchased for the Canadian line between Milford Haven and Paspebiac, Que., the first sailing in November. Satisfactory arrangements have been made for a special service of trains between London and Milford Haven.

Louis Lacouture, Sorel; J. O. Blondin, La Baie des Peres, Que.; D. Gillies, M.P.P., Carleton Place, Ont.; James Gillies, Carleton Place, Ont.; John Gillies, Braieside, Ont., have applied for Ontario incorporation as the Lac Temiscamingue Navigation Company, Ltd.; capital, $50,000.

Inventor Knapp, of Prescott, of the roller boat fame, has returned from Chicago, where, he states, he has succeeded in forming a strong company to carry out his roller boat patents. It will be called the Lakes Roller Boat Transportation Co., and will this winter construct a large roller boat 120 feet long. There is no reason, we believe, that if one Ottawa man financed a small roller boat several Chicago men should not finance a large one.

The manager of the Atlantic Transportation Company, W. S. Besse, New York, is buying a fleet of lake vessels for ocean service. The company was organized about a year ago, with a paid-up capital of $3,000,000, with the intention of engaging, on a more elaborate scale than any existing company was doing, in the coal-carrying trade of the Atlantic Coast. A large fleet was secured and now it is being added to by the purchase of nine steamers, at an average cost of $50,000, and thirty-five schooners, at an average cost of $20,000, or a total investment of $1,150,000. The vessels are as follows: Steamers Aragon, Kataloive, Murphy, Moore, Viking, Gettysburg and Lindsay; barges, Bacon, Georgia, Alverston, Crossthwaite, Moonlight, Verona, S. H. Foster, Sheldon and Watson; bought from J. G. Gilchrist & Co.; Redwing, Santiago, Iron State and S. V. L. Watson, bought from Parke & Miller; Wadena, Becker and Ash, bought from W. D. Becker & Co.; O'Neill & Wall, bought from C. R. Jones & Co.; Camden, Massa, Soit, Page, Sage, Milacomet, bought from Drake & Mathan; Fitzpatrick, Brown, McGregor, Parker, Rutter, Porter, Halloran, Helvetia, Wallace, Hawgood, Ewen and Shawnee bought from various companies.

Personal.

A. F Genest, C.E., is now engaged upon work in connection with the Cornwall Canal.

Peter Brass, architect, Hamilton, Ont., has been appointed building inspector of the Grand Trunk Railway.

R. K. Oliver, who has been filling the position of C.P.R. locomotive foreman at Chapleau, Ont., for some years, has been transferred to Hochelaga.

Town Engineer C. H. Mitchell, of Niagara Falls, Ont., has recently been in Potsdam, N.Y., engaged upon extensive works to generate electric power.

N. R. Carmichael, lecturer in mathematics and electrical engineering in Queen's University, Kingston, Ont., recently married Miss M. A. Jenkins, of Strange, Ont.

Arthur Graham, who has been with the MacGregor-Gourlay Co., Galt, Ont., for some years, has gone to Sherbrooke, Que., to enter the draughting rooms of the Jencks Machine Co.

Mr. Cowles, a locomotive engineer on the Leamington, Ont., division of the M.C.R., and Thomas Reid, foreman of the round house there, have both been sick for some time, and both died on October 8th.

Thomas Jones, for a long time employed with the Yarmouth Steamship Company as a quartermaster, died of typhoid fever, at his home, Jordan Falls, N.S.

W. M. Davis, who for the past thirteen years has been the town engineer of Woodstock, Ont., has been appointed town engineer of Berlin, Ont., at a salary of $1,500 a year.

Miss Myssie Munro, daughter of J. W. Munro, Pembroke, Ont., the well-known contractor, was married recently to Wm. Russel, jr., of the firm of Russel, Poulin & Co., contractors.

R. H. Cushing, C.E., has received the appointment of assistant engineer of the I.C.R. His special duties for the present will be to look after the terminal works at St. John, N.B.

Thomas Cowan, postmaster, Galt, Ont., died October 14th at the family residence, near Galt. Deceased was one of the first members of the firm of Cowan & Company, machine manufacturers, Galt.

At a recent meeting of the Ottawa city council a resolution was passed discharging the city engineer, Robert Surtees, the dismissal to take effect on November 30th. The applications for the position are very numerous.

Arch. Blue, of the Ontario Crown Lands Department, recently attended the annual convention of American Institute of Mining Engineers, in Buffalo. While there Mr. Blue delivered an address on "Corundum in Ontario."

Henry Wagner, a moulder employed at Clare Bros.' foundry, Preston, Ont., recently met with a terrible accident. He was carrying a ladle of molten metal and in some manner stumbled, with the result that a quantity of its contents was spilled over his right foot, which was frightfully burned.

Manager Keating, of the Toronto Street Railway Co., who was elected vice-president of the association at last year's session, when he was city engineer of Toronto, accompanied C. H. Rust, C.E., Toronto, to the convention of municipal engineers in Washington, D.C., at the end of last month.

Richard C. Boxall, C.E., Sackville, N.B., whose failing health has for some time been the cause of great anxiety to his friends, is now suffering from a mental malady, and all will regret to know that it has been thought best to send him to the Asylum for the Insane at St John, for treatment.

C. H. Sutherland, mechanical engineer of the Grand Trunk Railway, died very suddenly a short time ago. He had been confined to his residence for several days, but no serious results had been apprehended. However, when one of the family went into his bedroom Mr. Sutherland was found dead in his chair. Heart disease is presumed to be the cause of death.

John Duffy, St. John, N.B., foreman of construction work at the new pulp mill at Mispec, while directing work on the roof, fell over to the ground, 40 feet below. He struck a staging in his descent, thus breaking the force of his fall. His arm was injured, several ribs broken, and he also suffered severe internal injuries.

Word was received in Toronto, Oct. 26th by cable of the death in South Africa of Lieut. Keating, son of E. H. Keating, C.E., general manager of the Toronto Railway Company. Lieut. Keating graduated from the Royal Military College, Kingston, in 1888, and joined the 100th regiment, under Col. Trench, lately stationed at Halifax, N.S., and was about three months ago ordered to Africa.

Prof. Alexander Graham Bell, the inventor of the telephone, owns a whole mountain of 1,000 acres in Baddeck, Cape Breton, upon which he has expended a large sum on roads. Upon its southern slope up toward the summit, and overlooking a wide panorama of lake and mountain, he has erected a mansion, and near it a fully equipped laboratory where he conducts his experiments in electricity.

W. H. Aldridge, the manager of the Trail smelter and refiner, the property in British Columbia acquired some time ago by the C.P.R., has recently visited Montreal, and other Eastern centres. Mr. Aldridge took charge of the works at Trail when the property was purchased from the Heinze syndicate, and since that time a great revolution in the works has been effected. The plant is being worked to its fullest capacity.

Dr. Porter, Professor of Mining and Metallurgy in McGill University, Montreal, is back at the University entirely recovered from his recent severe illness. During the summer Dr. Porter has examined the mining areas in Nova Scotia and British Columbia, and is much impressed with the possibilities of mining in both districts. While in British Columbia, Dr. Porter visited East Kootenay and other districts, but was taken ill before he had examined the West Kootenay country. Dr. Porter's many friends are delighted with his complete restoration to health.

ELECTRICAL POWER TRANSMISSIONS.[*]

BY R. A. ROSS, E.E., M. CAN. SOC. C.E.

(Continued from last issue).

Owing to the copper losses and induction effects at various loads on the system from the generator shaft to the lamps or motors, the generator voltage must be raised as the load increases. It is very desirable that this increase be kept as low as possible, so that a continual adjustment of the voltage be not necessary, rendering the lights unsteady. To this end the copper losses, and especially the induction effects, must be kept within bounds. The first involves only the cost of the copper, the latter depends upon the nature of the demands and the relative positions of the copper conductors. The induction of lines and apparatus has an effect somewhat similar to that of the inertia of water in long pipes, and causes the current to lag behind the voltage, necessitating a large output of volt-amperes to produce watts, and, as lines and apparatus must be of sufficient capacity to carry the useless increase of current and the generator to allow for the useless additional volts, an increased capacity of plant is necessary. These induction effects may have a larger influence on the regulation than the necessary copper losses, and should be carefully watched. It is well to bear in mind, however, that the increased volt-ampere readings do not represent additional power consumption, as would be the case in direct current, as they have to be multiplied by the cosine of the angle of lag (which is always less than unity) to give the true power. Poor regulation therefore cuts down the capacity of the plant, and renders it difficult to maintain the voltage constant under varying loads. Having thus sketched the main points, which affect the general working of the plants, the apparatus may be taken up in detail.

The reducing transformers necessary for lowering the line voltage to that suitable for the incandescent distribution, arc light motors, and rotary transformers for railway service, must be of the highest grade to stand the line potential, as well as the increases of voltage to which they may be subjected under certain conditions. Of course the efficiency should be of the highest and the regulation good. As the heat developed is great, an air blast or circulation of cool oil is provided. The rotary transformers which form such a large part of the load in this case partake both of the nature of alternating motors and of direct current generators. As an alternating current motor of synchronous type they must be self starting, and in consequence are of either two or three phase. As a generator they must at the speed established by the synchronous motor part give the necessary direct current at the proper voltage for the trolley line, as both the motor action and the voltage generation take place in one set of armature windings, and as the fields are common to both, there is a certain ratio of impressed alternating voltage to direct voltage at the commutator, which is constant, and any change of field strength alters the direct current voltage only indirectly by causing a leading or lagging current in the transmission lines, thus giving more or less volts to the alternating side of the machine. Owing to this effect of over or under excitation of the rotary upon the line currents, causing them to lead or lag behind the voltage, this apparatus may be arranged to keep the current and voltage of the line in phase, thus doing away with the troubles from lagging currents which so unfavorably affect the system in the matter of regulation. On the other hand, where there is no necessity for close regulation, the line induction is encouraged, and is found useful in over-compounding the direct current side of the rotary automatically, thus giving the rise of voltage with load so desirable in railway work. In the present case, if the lighting and railway loads be carried upon separate lines, the latter arrangement is desirable, as the lighting will have good regulation while the railway service will over compound automatically. The total load for railway needs being 6,450 E. H. P., and the average from 7 a.m. to 9 p.m. being 3,000 E. H. P., seven units of 1,000 E. H. P. should cover the demands, and the machines in operation should have a good load factor. For the arc light demands as before stated, eight units would be sufficient. The motors may be either synchronous or induction, the former preferably as they may be useful in assisting the regulation of the incandescent lighting service by proper excitation, as their loads do not fluctuate. This apparatus with the necessary switchboard and instruments for the high potential receiving and lower potential distributing circuits, completes the distributing station equipment.

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[*] From a paper read before the Canadian Society of Civil Engineers.

The line is usually the weakest link in the chain, being exposed to the weather, and not under that careful supervision which is given to the rest of the plant. The pole line as a supporting structure must of course be of the solidest to stand the strains imposed, not only by the weight of copper, but in these latitudes by a great weight of ice also, which if assisted by a gale will try the best work to the utmost. Poles of cedar, pine, or chestnut of very heavy section are necessary for this work. They should be set in concrete or broken stone and heavily guyed on curves, or in certain positions double poles with heavy cross arms between should be used. The insulators for high potential work are universally made of porcelain, as that material weathers better than glass and is not so hygroscopic. This porcelain should be so vitrified as to exhibit a fracture like glass when broken, otherwise it will absorb moisture and break down. To minimize surface leakage, which, if severe, may burn off the pins, the surface over which it has to take place is made as long and of as small surface as possible. To assist in reducing this leakage, insulators with oil in grooves, over the surface of which the leakage must take place, have been tried and found to work well when the oil surface is clean, but in operation dirt accumulates and troubles ensue so that the plain porcelain insulator of large insulating surface and high resistance to piercing is now the standard.

The copper circuits are of bare copper, as weather-proof insulation at high voltages is perfectly useless. The cross section of the copper being of course so proportioned as to give the loss determined upon as suitable for the conditions existing. These conditions depend upon the cost of the power, the amount available and the demands. The loss may be reduced to any extent by the use of more copper, but unless there is a demand for the power saved, which will pay interest and depreciation on the additional cost of circuits, no economy results. On the other hand, the copper may be reduced and the losses increased, but only within the bounds set by the demands of good regulation. In practice a loss of 15% is seldom exceeded, and a very common allowance is from 7% to 10%.

Several effects manifest themselves in alternating lines which do not exist on those of direct current systems, and they deserve the closest attention in planning the system. While the actual losses in direct and alternating work are about the same under the same conditions, the drop in voltage in the former is a measure of that loss, while in the latter it may be no indication. In fact, it is possible to so arrange the circuits in some cases of alternating work as to have a greater voltage at the end of the circuit than is generated at the station, but this does not indicate that the line generates power of itself; it simply means that, while the self-induction and capacity of the line and load raises the voltage, much as a water ram in a pipe line raises the pressure, it at the same time throws the current out of phase with that voltage, and the real power is that obtained by the multiplication of the apparent volt-amperes by the cosine of the angle of lag introduced. It is therefore only possible to read the power indications of a Watt-meter, which instrument takes account of this angle while the volt and ampere meter readings which are used to determine direct current power are not reliable for the alternating. This increase of voltage may under certain conditions become so serious as to endanger the insulation of line and apparatus. In most cases it is advisable to reduce the induction as much as possible, and to effect this the wires on opposite sides of the circuit are strung as closely together as is consistent with safety, and several wires of equivalent cross section used rather than a smaller number of larger area. To do away with unbalancing of the phases of the system, the circuits should be strung symmetrically, which is effected in the case of two phase lines by placing the going and returning wires of each phase on the opposite ends of the diagonal of a square, and in three phase lines by stringing the three conductors at the corners of an equilateral triangle. As lightning may cause trouble, not only by direct stroke, but by the accumulation of static electricity upon the lines, means must be provided for getting rid of it safely. To this end, guard lines of barbed wire are strung above the circuits, and these are grounded at frequent intervals.

The apparatus in the generating section of the plant consists of the water wheels, generator, raising transformers and switchboard apparatus. Regarding the latter two, the same remarks apply as were made regarding similar apparatus in the distributing station. As to the generators, their size is usually limited by the power of the water wheel units, and their speed by the wheel speed unless gearing be used. The usual method of attacking the question with direct connected units is to arrange for as powerful wheels as is possible consistent with having the proper size units to handle the load properly, and designing the generators properly to suit the wheels as regards size and speed. Vertical turbines with the rotating part of the generator revolving in a horizontal plane are usual, but, in several recent plants, horizontal turbines are used direct connected to the generators, which in that case are below the crest of the dam and above the tail-race by an amount determined by the height of the draft tube. The first system introduces footstep bearings, which are always more or less objectionable, but removes the delicate armature windings from chance of damage by water. The second places the generator at the mercy of water-tight bulkheads and stuffing-boxes. As to the voltage to be generated upon the machines, if raising transformers are used, this is of little consequence unless from a machine designer's point of view, as the transformers will have equal efficiency at any ratio of transformation. When the transmission voltage is not dangerously high, it is of course preferable to do away with these transformers, and generate directly on the machine. In deciding this point it must be kept in mind that the failure of a transformer through the breaking down of insulation is a much less serious matter than that of a generator, which is less likely to occur when that apparatus is of low voltage. Owing, however, to improved types of generators, we may expect to see raising transformers dispensed with in many cases where they would have been deemed indispensable with older types.

In specifications drawn up for the generating apparatus, the following points are strongly insisted upon : (1) That the heating of any part shall not exceed a certain specified temperature after a certain length of run at full load and an additional time at a certain specified overload. (2) That the efficiency at full load, three quarters, one half, and one quarter loads, shall be guaranteed by the tenderer and proved by test. (3) That the regulation of the generator shall be within a certain per cent. at full non-inductive load. (4) That the insulation of any part of the machine shall not break down under a specified voltage which is high enough to allow of a good factor of safety over the normal pressure. Although it is impossible to specify limits for these requirements which will suit every case, it may be said generally that the allowable increase of temperatures for large generators ranges from thirty to forty degrees centigrade. The full load efficiency from ninety-four to ninety-six per cent. The regulation depends upon whether the machine is compound wound or not. In the former case the regulation may be anything for which the compounding is set, and in the latter from three to ten per cent. The test voltage applied ranges from three to ten times the operative, the former factor for high voltage machines, the latter for lower voltages. The modern generator being either of the inductor, or revolving field type, in which the high potential armature windings are stationary, lends itself to high voltage generation, as the insulation spaces may be increased largely without rendering the machines unwieldy, for the reason that the armature wires are distributed over the outside ring where space is more abundant, and the vibration of running, which abrades, and finally breaks down the insulation on the older revolving armature types is largely absent in the newer machines.

(To be continued.)

WANTED—Position by stationary engineer, second-class certificate of the Ontario Association. Ten years' experience; strictly temperate. Apply "NORWOOD," care Canadian Engineer.

PERSONAL—Will Mr. H. Weir, who formerly resided at 42 St Alexander St., Montreal, kindly communicate with us. Any friend of Mr. Weir knowing his present address will oblige by calling his attention to this advertisement. BIGGAR, SAMUEL & CO., Publishers Canadian Engineer, Fraser Building, Montreal.

TENDERS FOR BRIDGE CONSTRUCTION

OFFICE OF THE QUEBEC BRIDGE CO., LIMITED

Sealed proposals for the construction of a combined Railway and Highway Bridge across the River St. Lawrence, near Quebec, will be received by the undersigned until noon, Monday, January 2nd, 1899.

Forms of tender, with circular of conditions, specifications, &c., can be had on application to the undersigned.

The company does not bind itself to accept the lowest or any tender.

ULRIC BARTHE, Secretary

Quebec, September 24th, 1898.

The Canadian Engineer

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MASONRY PIER MOVED BY ICE AND REPLACED.*

BY R. W. LEONARD, M. CAN. SOC. C.E.

During the winter of 1895-96 the masonry for the four spans of the bridge which carries the St. Lawrence and Adirondack Railway (since leased to the New York Central and Hudson River Railway) over the Chateauguay River, Province of Quebec, was constructed.

The river at the crossing is 600 feet wide, and is spanned by four through steel spans of 150 feet each. The river is from 8 to 12 feet deep at low water, the bottom being clay, with some gravel in places and a few scattered boulders.

The abutments were built on shore; 75 piles were driven through the ice for each pier, and cut off by hand with a cross-cut saw carried in a light, stiff hardwood frame, just above mud-line. Field stone were filled in between piles to a level with top. A caisson was framed with double 12 x 12 bottom caulked, and double plank sides with tar paper between the planks, and sunk in place by the masonry as it was built inside. Rip-rap was finally placed round the piers to a height above the timber platform to prevent scour.

The abutments and two westerly piers were completed and two spans erected and resting on them. The easterly pier was just erected and two men were pointing the masonry on a warm spring day, when the ice shoved in the river and went out very suddenly. The winter had been exceptionally severe, with but little snow-fall, and the ice was strong, especially where it had been worked on all winter close to the bridge, at which place it was about three feet in thickness. A very large field of ice drifted down from the basin, lodged against the west shore and the westerly piers and swung against the unfinished pier, striking it obliquely on the westward side of the ice-breaker.

The field of ice was immediately broken in pieces by the piers and passed on, apparently doing no damage. On close inspection and measurement, however, I found that the easterly pier had moved out of position.

To replace the pier I built a crib as shown on the plan, sunk it in place, drove a row of piles behind it, loaded the top of crib with stones, and set four hydraulic 50-ton jacks between crib and pier. These moved the pier two inches, and the bottom of the platform then stuck on the head of the corner pile from which it had been pushed. A diver, who had been employed to remove the rip-rap around the pier and to examine the foundation, was instructed to cut this pile down half an inch, and a second and successful attempt was made with three jacks, two of 100 tons and one of 50 tons capacity. The pier was moved back to its proper position without showing the slightest crack in the pointing, or any other damage.

Additional rip rap was placed around the pier, the crib removed and piles cut off close, at a total cost of about $800.

There has been no further difficulty.

The weight of the pier is about...960,000 lbs. in air
Hemlock platform " .... 50,000 "
1,010,000 " or 500 tons

Plan shows level of water when ice moved, and level of water at time when pier was replaced.

The facts may be interesting to Canadian engineers, as they show the dimensions of the masonry and the conditions existing in the case of a pier that just moved, and the force necessary to shift it on its foundation.

WEIGHTS ON FOUNDATION WHEN PIER WAS PUSHED BY ICE.

S.G. Limestone = 2.7
S.G. Hemlock = 0.7 say:
5/6 of masonry submerged say, therefore

Weight of pier at H.W.M. would be $\frac{960,000}{6}$ 160,000 lbs.
$+ \frac{17}{27} \times \frac{5}{6} \times 960,000$ 503,700
663,700
Less flotation of platform 3/10 × 50,000. 15,000
Net weight of east pier when pushed by ice 648,700
150-foot span weighed about 350,000 lbs.,
therefore weight on piers not moved would be
Centre pier $648,700 \times \frac{350,000}{2}$ 823,700
West pier $648,700 \times 350,000$ 990,780

WEIGHT ON FOUNDATION WHEN EAST PIER WAS REPLACED.

$\frac{1}{2}$ masonry submerged.
weight of pier would be $\frac{1}{2} \times 960,000$ 480,000 lbs.
$+ \frac{17}{27} \times \frac{1}{2} \times 960,000$ 302,222
782,222
Say 391 tons.

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*From a paper read before the Canadian Society of Civil Engineers.

Moved by 4 jacks of 50 tons, 200 tons.
Approx. co-efficient of friction, say ½ to 0.5 about.
Moved by 2 jacks of 100 tons and 1 of 50 tons, 250 tons.
Approx. co-efficient of friction 0.65.

Taking co-efficient of friction at ½, the thrust of the ice was about $\frac{648,000}{2}$ or 166 tons, or about 11 tons per square foot considering the ice three feet thick and striking the pier obliquely on a width of 5 feet.

THE STORAGE BATTERY FOR RAILWAY TRACTION.

As early as 1880, experiments in connection with storage battery traction were made in London, Paris, Brussels, Birmingham, Hamburg, New York, New Orleans, Washington and Dubuque. The short life of the batteries and the enormous expense of renewing the positive plates, resulted in failure, the battery quickly deteriorating under the care of the ordinary railway employees. In theory, as the Street Railway Review remarks, the storage battery did present many ideal conditions. "It provided a self-contained motor car with no outside accessories, as trolley lines, feeders, bonds for the transmission of the current. The electric current could be generated in a station free from overloads and troublesome peaks, at certain times of the day, and thus the station need only be of minimum capacity for the work required."

In Europe.

E. A. Ziffer, C.E., of Vienna, Austria, president of a local street railway, in an address before the International Street Railway Association, which met in Geneva last summer, reviewed all the present systems of mechanical traction, and sums up his conclusions in reference to the storage battery system in these words: "Accumulator traction, which might be considered the ideal, is still in the experimental stage, in spite of the good results already obtained. It continues to be a subject of great interest, and has a hopeful future." The weight of the batteries has always been a detriment to the working of the storage battery system of traction. Mr. Ziffer gives the weight of the battery, with all accessories, capable of operating a double truck car, weighing 12½ tons, English, for a distance of 9½ to 12½ miles, as 1.2 tons, English. The Ribbe Accumulator, which has been tested on one of the lines in Berlin, is lighter than the usual type, the weight for a capacity of 300 amperes-hours at a pressure of 260 volts, being 3.4 English tons. Even this is very much heavier than the batteries which are being made in Canada, which were mentioned and illustrated in our October number; but notwithstanding the enormous weights of the European and American batteries, very satisfactory progress has been made on both continents. The Wurtemburg State railways are making an important test of the value of storage batteries for traction purposes, and have put in operation near Stuttgart, on a line 14½ miles long, a storage battery car seating 48 passengers, the battery having 188 cells, weight, 5.8 tons (weights are stated in English tons), and giving a capacity of 16,000 watt hours. In a test made in September, 1897, with this car, which weighed, with passengers, 28.75 tons, the current consumption was from 29.34 to 30.45 watt hours per ton mile, at an average speed of 19 miles per hour—a very satisfactory result. Similar experiments are being carried on in Belgium on the Brussels-Liege line. In Paris, 35 storage battery cars are in use, the batteries alone weighing 3.5 tons out of a total of 14 tons per car, loaded with 52 passengers. The time of charging the batteries is from 8 to 12 minutes. The battery contains 54 ampere-hours. The Ostend Tramway is operated by accumulators.

Since March, 1896, two accumulator cars have been in use on the narrow gauge lines near Darmstadt. The cars carry 32 passengers, and weigh, without passengers, 8.1 tons, of which the battery weighs 2.3 tons. The plates are of the Plante type, and have a capacity of 30 ampere-hours, with 4.20 volts, average E.M.F. From April, 1896, to August, 1898, these cars made an average of 62.14 miles per day, and the consumption of current has been 645 watts per car mile. Up to the spring of 1897, no trouble had been experienced with these cars, therefore the Railway Commissioners decided to install some larger cars, which will soon be in operation. In May, 1897, two 24.4 ton motor cars were put in operation on the Ludwigshafen, Neustadt & Worms lines, having a total length of 32.3 miles. Each car weighs 11 tons, battery, 9.3 tons; motor and accessories, 4.1 tons. A single charge of the battery makes the round trip at an average speed of 15½ miles per hour. Each car carries 36 passengers, and draws one trailer carrying 50 passengers. The cost of operation, including wages of conductor and motorman, fuel, oil and waste, is 28.65 cents per train mile. On the Frankfort-on-Main tramway, the battery weighs 2 tons, and the empty car, excluding the battery, weighs 6 tons The battery is stored in 4 or 5 minutes, and this charge lasts for short round trip of half an hour. In Munich, where the overhead trolley is not allowed, a storage battery locomotive is about to be put in operation, to draw a trail car. On the Berlin-Charlottenburg line the battery consists of 180 cells of 260 ampere hour capacity. The car body and truck weigh 19,316 lbs., battery, 15,048 lbs.; 2 motors, with gears, 3,300 lbs.; total, 37,664 lbs. When loaded with 42 passengers, total weight is 43,000 lbs. With the battery on this car it makes ten round trips a day, covering 90 miles a day, at an average speed of 9.3 miles an hour, but 14.25 miles per hour is the best performance.

While the overhead trolley system is the one most generally adopted in Europe and America, and in the opinion of Mr. Ziffer is the most simple, the most economical, and the one which has given in practice the best results up to the present time, he concedes that "It is a very difficult thing to say which among all the mechanical systems of traction is the most desirable from an engineering and economical standpoint. It is necessary to take up each condition individually, and weigh carefully all the relative circumstances in construction and operation."

The list of systems is now rather extensive, and may be grouped as follows: Steam—Rowan, Serpollet, Clark systems; Stored Steam Locomotives—Lamm-Francq & Dodd systems; Compressed Air—Merkarski, Popp-Conti, and American Air Power Company's system; Gas Benzine and Petroleum Motors—Lubrig, Daimler and Diesel systems. There are, also, the cable system, the overhead trolley, the electric conduit, the surface contact, the third rail, and the mixed electric systems—combination of accumulators, and overhead,

In America.

During the past five years, experiments in accumulator traction were made on a commercial scale in New York, under the auspices of the Julien Company, which for a considerable time operated 10 or 12 cars on the 4th avenue road. Trials more or less successful were also made in Philadelphia, New Orleans, and the other American cities, above mentioned. The most successful storage battery road in operation in the United States is that of the Chicago Electric Traction Company, which runs a line about 20 miles long between Chicago and Englewood. There are no stations on the line along the route, the entire line being within the city limits, although the most of it is through only sparsely-settled territory. The cars are required to stop at all street crossings to let off and take on passengers. The batteries weigh 3½ tons per car, each battery consisting of 72 cells, and having a capacity of 400 ampere hours, while the weight of car, equipped with batteries ready for use, is 16 tons. The weight of rail is 80 lbs. Eight regular cars run on week days, but on Sundays and holidays as many as 40 are used, including trailers. Owing to the weight of the cars, they cannot be started and stopped as quickly as a trolley car, which only weighs 8 or 9 tons; but this inability results in more care on the part of the motormen, who always pass vehicles with the power shut off, giving them a better opportunity to use the brakes. The "accident account" is surprisingly low, only two-thirds of one per cent. of the gross receipts, while the usual rate for a suburban trolley line is 2 per cent. Motormen are trained to "coast" as much as possible, the weight of the cars enabling them to coast faster and further than would be otherwise the case. Snow storms have been successfully handled with but one plough, weighing 22 tons, and one sweeper, weighing 26 tons, for 26 miles of track. The manager, E. R. Gilbert, who was formerly connected with trolley lines, reports that he got more work out of these appliances than he had ever seen accomplished with machines operated by trolley. In one case they cut through a drift 7 feet high, and several hundred feet long, by "bucking" the drifts with a plough. Cars have been run 40 miles on one charge, but the conditions for such a long run are so often unfavorable that it has been found advisable to change the batteries every half trip of 11 miles, the power-plant being located in the middle of the system. By doing this, cars are able to carry trailers and make the trip under all conditions. Passengers do not seem to mind in the least the slight delay caused by changing the batteries, which takes only 1¼ minutes. The road-bed is nearly level, except one hill about 300 feet long with a grade of 9½ per cent. With a dry rail the cars easily climb the hill without assistance. In one instance, two loaded trailers were hauled, a counter-weight system being provided to prevent accidents and slipping.

"Our cars average over 200 miles per day," Mr. Gilbert says, "at an average speed of 12 miles per hour. Passengers, one and all, agree that riding on them is much more pleasant than on any other system, as the cars ride very smoothly, owing to their weight, without the unpleasant noise of the trolley or the jerking of the cable system. The advertising resulting from these conditions is worth considering." An element of importance is the fact that the whole line cannot be shut down at once, as all cars are independent of each other. There is no necessity for a wrecking wagon, as a wrecking car can always be sent out, as on a steam road. The steam plant (power-house) is also more independent than on a trolley road, as it can be shut down two or three hours without interfering with the service in the least. Current for lights in the office, barn and power-house is taken direct from the batteries, therefore there is no necessity to run the plant all night. It is closed down at 11 p.m., although the last car does not reach the barn until nearly 1.30 a.m. The load on the engines and dynamos is always constant.

Wear and tear on trucks, wheels, roadbed, and special work is very much heavier than on a trolley system, because of the great weight of the cars. We use an 80-lb. girder rail and all crossings, etc., are made extra heavy, but even then the cost of maintenance is very great. The depreciation of the batteries is 2c. per car mile, as against the depreciation of overhead work and rail bonding on a trolley road, which would amount for similar mileage to about $4,325 per year. Operating expenses average 8 2-3c. per car mile, comparing favorably even now with those on trolley systems, but the difference will be greatly in favor of the battery line, as the service on the latter grows towards the capacity for which the plant was built. "I see no reason," Mr. Gilbert adds, "why a storage battery system under fair conditions cannot be operated fully as cheaply as a trolley line." Taking a basis of 20 cars, and the mileage of the Englewood road, the difference in cost of construction of that particular road would be only about $25,000 in favor of the trolley system. To offset this slightly greater expense is the unquestionable advantage of having no overhead work of any kind to mar the appearance of the streets through which the road runs, or to add the element of danger to the public from live wires or electrolysis.

The numerous facts and data cited by Mr. Ziffer, as to the installation and operation of various systems in different parts of Europe, show that the accumulator, or storage battery, stands well the test of comparison. The following table is very interesting and instructive in this connection. It is given by Mr. Gofferneaux in his work on "Mechanical Traction for Tramways," and is a theoretical comparison of the cost of the different systems, including 10 per cent. fund for depreciation on the capital invested, and based upon an annual traffic of 621,382 car miles. The figures are in cents per car mile.

System of Traction.	Operation.	Depreciation.	Total.
	c.	c.	c.
Serpollet (steam)	9.7	3.5	13.2
Rowan (steam)	11.3	3.5	14.8
Electric accumulators	10.9	4.2	15.1
Trolleys	10.0	5.5	15.5
Gas motor	13.9	3.5	17.4
Compressed air	13.55	4.85	18.4

It will thus be seen that in point of economy, electric accumulators are superior to the popular trolley, while compressed air is at the foot of the list.

Reduction in the weight of batteries would materially lessen the cost of construction in a storage battery railway, as lighter cars, rails, and equipment generally could be employed. In competition with the trolley, the construction of which costs per single mile, according to Mr. Pearson, of New York, $16,650, the storage battery ought to have a good fighting chance on the trolley's own ground. We would suggest to the engineers whether it might not be possible to devise a simpler and lighter system of construction, taking into consideration the particular necessities of the case, that will fill the conditions required in this wooded country, in the more sparsely-settled districts, and in connection with mining and lumbering camps.

—The report on the gold deposits in the Province of Quebec just issued by J. Obalski, the Government mining engineer, which bears date June, 1898, is a pamphlet of some hundred pages which gives a very interesting historical outline of the gold mines of the Chaudiere valley, which are now the property of the De Lery family, being part of the famous seignorial grants of Rigaud-Vaudreuil of 1736, to which the gold rights were added in 1846, and comprise 71,000 acres divided into thirteen mining sections.

—The report of the street commissioner of St. Louis, A. N. Milner, is an interesting and beautifully illustrated publication, which shows the present position and progress of the city. We learn that the population is now 651,821, and the bonded debt is $19,959,278. The city bridges have cost, with approaches, $1,513,618. The macadam of the improved streets costs $16,500 per mile in St. Louis, but the curbs and gutters are either of brick laid on concrete or granotoid, which of course adds enormously to the wearing and serviceable qualities of the road-bed. One-half the lanes in the city have been paved at a cost varying from $30,500 per mile for granite blocks to $12,000 per mile for limestone blocks.

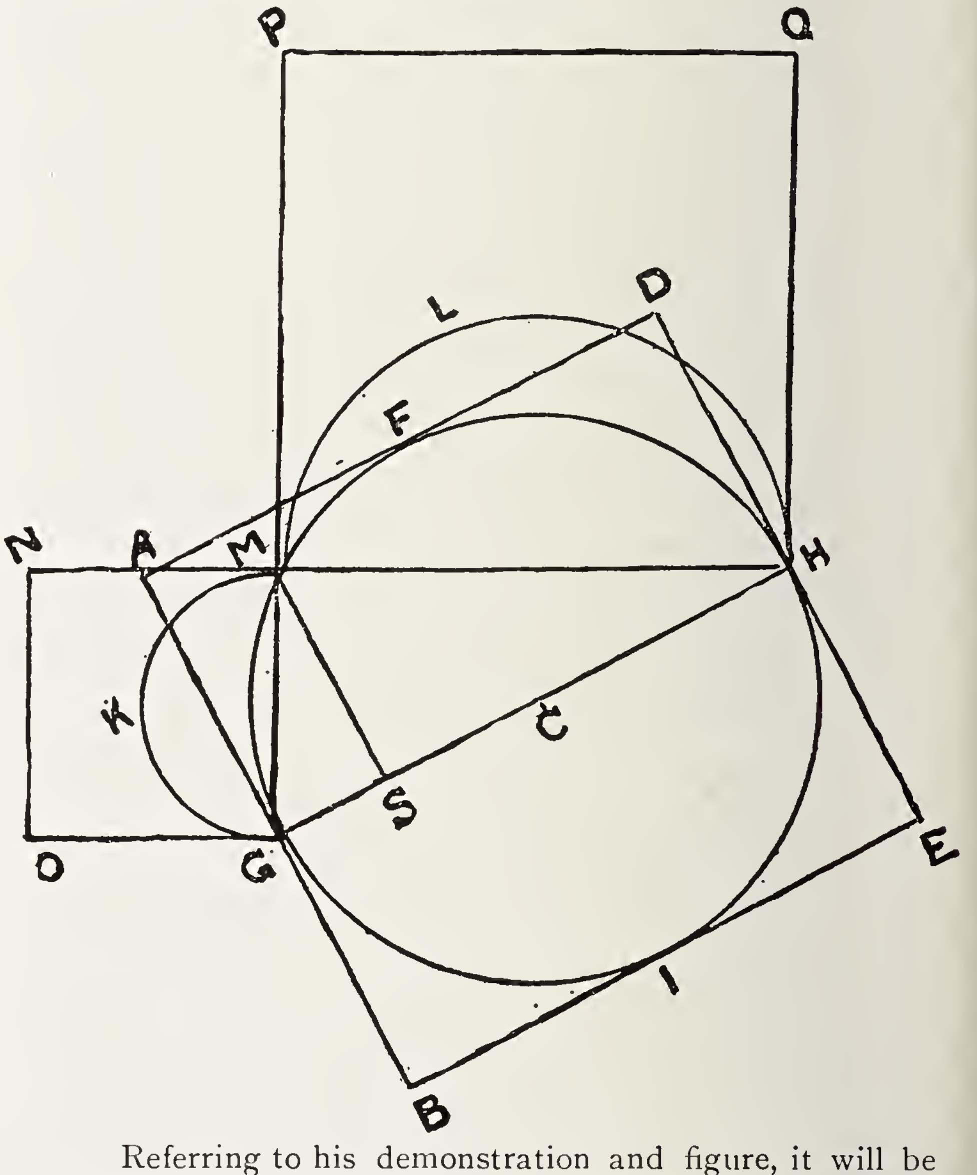
—The report made by C. H. Rust, city engineer of Toronto, on the subject of sewage disposal with reference to the present undesirable conditions in Toronto, contains a great deal of information in a concise form. But we think some of the methods of disposal might have been more fully discussed, nor do we quite see that the matter narrows itself down to intermittent filtration at a first cost of $1,730,000 and an annual charge of $70,000 ; or precipitation works at a first cost of $1,540,000 and an annual charge of $105,000, as the Toronto engineer concludes. Any conclusion in the matter of sewage disposal is most unwise until the Royal Commission appointed by the Imperial Government has made its report, which will be prepared after examining the promoters and operators of all known systems upon oath. Any town which goes to the expense of asking its own engineer to prepare a report on the subject in the meantime is merely wasting its money, because no engineer can examine all known systems himself, nor can he ask questions which are sure of truthful answers from the promoters, because they are not upon oath.

TO SQUARE THE CIRCLE.

The following criticism of the recently published solution of the old problem has been written for The Canadian Engineer by one of the most able mathematicians in Canada, one who is considered an authority on mathematics and kindred subjects, throughout the continent :—

E. Stone Wiggins, B.A., M.D., LL.D., of the civil service, Ottawa, is to the front with what he believes to be a successful squaring of the circle. Unhappily for him he is no more successful than others who in modern times have battered what they were pleased to call their brains against this problem. Mr. Wiggins says there were four problems for which the ancient mathematicians in vain sought solutions : (1) Squaring the circle ; (2) trisecting any angle ; (3) duplicating the cube ; and (4) finding two geometrical means between two given straight lines. Had "Professor" Wiggins known more of mathematics than he does, he would have been aware that (3) and (4) are one and the same problem. And again, had he had a slight knowledge of mathematics he would have known that the accuracy of tables of lines and tangents does not depend on the size of any circle to which the angle may be conceived as having reference. The "Professor" seems to think the numerical values of the trigonometrical ratios are determined by measurement with a carpenter's rule.

But to come to the squaring of the circle. It would be too dreary a labor to go through his reasoning and point out where the fallacies creep in. Fortunately there is a more expeditious way of disposing of the "Professor" and his demonstration. The ratio of the circumference of a circle to its diameter, 3.14159. . . . , has been found approximately with absolute certainty. There is nothing more certain in science than that this is the approximate value of this geometrical constant. It has been determined in countless different ways, and always with the same result. It will therefore be sufficient for us to examine what value Mr. Wiggins' construction (for a square equal in area to a circle) gives to this ratio.



Referring to his demonstration and figure, it will be seen he claims that the square on MH is equal in area to the circle. But

$$MH^2 = \frac{GH^4}{AH^2} = \frac{16\ (\text{radius})^4}{5\ (\text{radius})^2}$$
$$= 3.2\ (\text{radius})^2$$

and area of any circle = (ratio of circumference to diameter) × (radius)^2. Hence if, as the Ottawa philosopher claims, MH^2 = area of circle, we shall have ratio of circumference to diameter of a circle = 3.2, instead of 3.14159. . . . , which latter it certainly is.

If it be urged as an objection to the preceding, that it shows Mr. Wiggins to be wrong, but does not show where he is wrong, the reply is that it disposes of his pretentiousness in an expeditious manner, and that in going thus far we have accorded to him more consideration than his exhibition of ignorance is entitled to.

We append the demonstration of the problem of squaring the circle which E. Stone Wiggins, B.A., M.D., LL.D., Ottawa, has recently published. On another page will be found a criticism of the demonstration:

CONSTRUCTIONS AND DEMONSTRATIONS:

Let F G I H be any given circle having its diameter G C H. About this circle describe the square A B E D touching it at the points F G I H. Join A H, cutting the circle at M. The square on M H is equal to the given circle F G I H.

Because G H is double G A, and the triangle M G H is similar to the triangle G A H, therefore, the side M H is double M G. Hence the triangle M G H equals the square on M G.

On M G describe the square M G O N which will be spoken of as the square on M G. On M H describe the square M H Q P which will be spoken of as the square on M H. Also, on M G, as diameter, describe the circle M K G which will be spoken of as the inscribed circle of the square on M G, or the circle on M G. Similarly describe on M H as diameter the circle M L H which will be spoken of as the inscribed circle of the square on M H, or the circle on M H.

It is evident that some straight line may be drawn from the point H to meet the arc G F, the square on which will equal the given circle. Let any line M H be by hypothesis this straight line.

Now, since the square on M H—the same construction being made—is equal to the given circle F G I H, it is equal to the two circles on M G and M H because these two circles equal together the given circle. Therefore, the circle on M G equals the rim of the circle on M H, that is the part of the square M H Q P which is outside its inscribed circle.

From the point M let fall the perpendicular M S upon G H.

Now, the circle on M H is to the cricle on M G as the triangle S M H is to the triangle S G M for they are similar figures described on M H and M G, the sides of the rightangled triangle M G H. Therefore, if the triangle S M H were formed into a circle the triangle S G M would become its rim in the same way that if the square on M H were formed into the given circle—for by hypothesis it is equal to it—the square on M G would become its rim. Hence, the rightangled triangle M G H must be the only triangle that can be described in the semi-circle G F H which is so divided by its perpendicular M S, that its parts, the triangles S M H and S G M, will have the same relation to each other as the circle has to its rim.

To square the circle geometrically, it will be necessary:

1. To divide the given circle into two circles, having the same relation to each other as the circle has to its rim.
2. To divide the rim of the given circle into two parts, having the same relation to each other as the circle has to its rim.

Then the smaller circle of the former pair will equal the larger figure of the smaller pair.

To illustrate from the figure: If the square on M H equals the given circle then the latter is divided into two circles, the circle on M H and the circle on M G, which are to each other as the circle to its rim; also if the triangle M G H is equal to the rim of the given circle, it is likewise divided into two parts by its perpendicular M S, the triangle M S H and the triangle M S G, which are to each other as the circle is to its rim. Or to express it in proportionals to meet the above two conditions, the circle on M H is to the circle on M G, as the triangle M S H is to the triangle M S G, in which the triangle M S H is equal to the circle on M G. That is, the circle on M G equals the rim of the circle on M H.

The reason the square on M H is equal to the given circle is that it is made up of the circle on M H and some regular figure also described on M H, and, which happens to be made by the construction, equal to the rim of "the circle on M H."

It will be noticed that the construction transfers the circle on M G from the left side to the right, forming the rim of the circle on M H, while it is represented on the left by the triangle S G M, which is really described like itself on M G.

Since the square on M H is by hypothesis equal to the given circle, it is the same multiple of the triangle M G H, which is described in the semi-circle of the given circle, as the circle on M G is of the triangle S G W, which is described on its semi-circle, because these are similar triangles. But the rim of the circle on M H being equal to the circle on M G, it is also the same multiple of the triangle S G M, demonstrating that the triangle S G M or its multiple is transferred from left to right and added into the square on M H. The rim of the circle on M H being, as already shown, equal to the circle on M G, it must be that it is the same multiple of the triangle S G M, that the triangle S M H is of the same triangle. That is, the triangle S M H is equal to the rim of the circle on M H, and therefore equal to the circle on M G, for they are both described on the side M H. The triangle S G M must then be equal to the rim of the circle on M G, and the triangle M G H must equal the rim of the given circle.

Because the square on M G may be either greater or less than the triangle M G H, according to the position of the point M in the arc G F, let the triangle M S H be by hypothesis equal to the circle M G. Now the circle on M G is to the triangle S G M, as the circle on M H is to the triangle M S H. Therefore the given circle (that is the two circles), is to the triangle M G H, as the circle on M G is to the triangle S G M, but the circle on M H and the triangle S M H are equal to the given circle. Therefore they are together to the triangle M G H, as the circle on M G is to the triangle S G M. Hence the circle on M H plus the triangle S M H, are to the circle on M G as the triangle M G H is to the triangle S G M.

But in the construction, when the square on M H was by hypothesis equal to the given circle, the latter was the same multiple of the triangle M G H, as the circle on M G was of the triangle S G M, and this would be true whatever be the position of M in the arc G F. When, therefore, the square on M H becomes equal to the given circle, it is the same multiple of the triangle M G H, as the circle on M G is of the triangle S G H. Hence the square on M H is to the circle on M G as the triangle M G H is to the triangle S G M, the same as in the previous construction. They must then be of the same construction. Therefore, when the square on M H is equal to the given circle the triangle S M H must be equal to the circle on M G. Then the triangle S G M is the rim of the circle on M G, and the whole triangle M G H is equal to the square on M G. That is, the side M H is double the side M G, as in the original construction. The square M H Q P in the original construction is therefore equal to the given circle F G I H.

The two conditions mentioned are here fulfilled for the triangle M G H, the rim of the given circle is divided into two parts, related to each other, as the circle to its rim. The given circle has also been similarly divided and the larger of the former equals the smaller of the latter.

That the circle on M G is transferred from left to right, forming the rim of the circle of the square that equals the given circle, or, rather that the rim of the circle in the square on M H is to the triangle S G M as the circle is to its rim; also, that by assuming that the triangle S M H is equal to the circle on M G, the regular figure on M H is increased by the circle on M G, produce H D to meet M P produced in the point V. Now, because the triangle S M H on the longer side of the triangle S G M is equal to the circle on its hypotenuse M G, so also must the similar triangle M H V, described on the longer side of the triangle M G H, be equal to the circle on its hypotenuse G H, that is, the given circle. Now, it will be seen that if a perpendicular M W be drawn to the base, H V, that the triangle H M V will be divided into two triangles, W M V and M W H, and these triangles are to each other as the triangle M S H is to the triangle M S G, that is, as the circle on M H is to the circle on M G. But the triangle M W H equals the triangle M S H, for they are similar and have the side M H in common, and the latter is equal to the circle on M G, therefore, the two triangles M W V and M W H are equal to the two circles each to each. The triangle M H V, therefore, must be equal to the square on M H in the same way that the circle on M H together with the triangle S M H are equal to the square on M H which equals the given circle.

Again, let the square on M H be equal to the given circle, and in the semi-circle M L H describe the rightangled triangle M L H equal to the rim of the circle on M H. Describe, also, the rightangled triangle M K G in the semi-circle M K G equal to the rim of the circle on M G. These triangles should be described on the upper side of M H and M G and on a separate sheet, as they would if drawn in the cut here given render it difficult and obscure. These should be similar to the triangles

S M H and S G M, the real triangles, which are turned down to form the triangle, M G H. Produce H L to meet M P in R. Since the rightangled triangle in the given circle to be equal to the rim of the given circle must be similar to the triangle M L H and equal to these two triangles, and must also be described on its diameter, G H, therefore, the base, H R, must equal G H. Hence the triangle, M G H, must be the rim of the given circle.

Lastly, it will be observed that as the apex M, of the triangle M G H, is moved along the arc G F, the area of the lunes G K M and M L H will increase or diminish as M approaches or recedes from F. These lunes, known as the Lunes of Hipparchus, are always together equal to the triangle M G H. Now there must be some point in the arc G F, where M may be placed so that the quadrilateral P G H Q, will be equal to the irregular circle G K L H I (made up of the given circle and the lunes), when the square H Q P M will, of course, be equal to the given circle. This can only happen when the lunes are equal to the square on M G. It will be observed that the lune G K M is always a part of this square, and that it is only when the remainder, after it is deducted, is equal to the larger lune, that the two lunes can form a square. But when the square on M H is equal to the given circle, the triangle M G H, to which they are equal will, as already demonstrated, form a square. But in the original construction the triangle M G H, to which the two lunes were equal, was equal to the square on M G, showing that the two lunes formed this square. Hence the latter construction must be the same as the original and the square on M H in the original construction is equal to the given circle.

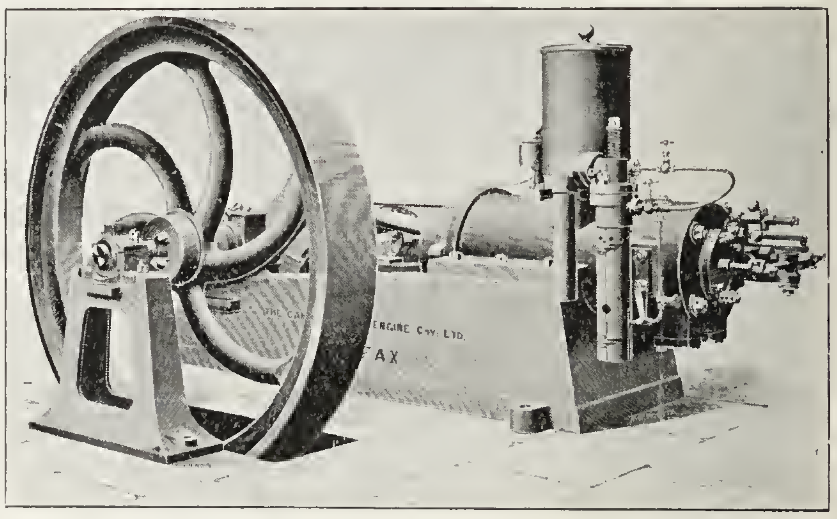
LOVE PUT OUT THE LIGHT.

The North Shore Power Co., which is supplying electricity for the city of Three Rivers, is generating it at Batiscan Chute and stepping it up to 12,000 volts for the purpose of a 16 mile transmission. A few evenings ago just as the dusk was coming on and the heavy load beginning to show on the ampere meters, the circuit breakers flew, the fuses blew and the lights were out. This lasted for perhaps ten minutes when the lights again started up and ran satisfactorily. The day following, the electrician naturally investigated to see what caused the trouble, and he found that a window had been broken in the sub-station at Three Rivers, and that some of Jean Baptiste's chickens had sought a roost on the bare copper wire, and as Chanticleer kissed Biddie "good-night" it completed the circuit, electrocuted the lovers and put the lights out.

This, perhaps, is one of the most uncommon short circuits or reasons for trouble that has occurred in Canada, and is a pointer for other electricians who may have power houses with broken window panes.

THE "CAMPBELL" ELECTRIC LIGHTING TYPE OIL ENGINE.

The Campbell Gas Engine Co., Ltd., Halifax, Eng., the largest maker of oil and gas engines in the world, having been called upon to supply several of its oil engines for electric lighting purposes, has decided a short time ago to introduce an oil engine specially for this work, which has proved a great success. To absorb the irregularities in speed due to the peculiarities of the "Otto Cycle," on which all oil engines are constructed, and the irregularity caused by changes in load, the Campbell Company states, the special engine is fitted with one heavy fly-wheel of large diameter. The crank-shaft is provided with a third or outer bearing, so preventing any undue strain being put on the shaft, which would be the case if the fly-wheel was unsupported or over-hung. The moving parts of the engine are balanced as nearly as possible by weights fixed rigidly on the crank webs. Automatic lubrication is provided for the crank pin, so that long runs can be made without stoppages for oil purposes. The engine is also provided with a special governor, driven direct from the crank-shaft of the engine, independent of other gearing by means of skew-gear wheels with machine-cut teeth. Every detail of the engine has been carefully studied to fit it for exacting and continuous work. It is provided with a special splash cover over the crank, and oil trays are fitted to the bed to catch the waste oil. From experiments made with these engines the makers state that variation in speed does not exceed two per cent., so that these engines can be relied upon for the steady running of incandescent lamps.



The "Campbell" Electric Lighting Type Oil Engine.

"A large installation has recently been put into the New Palace Theatre just erected at Plymouth, Eng.," says an article in The Electrical Review of October 28th, 1898. "The installation consists of 1,200 incandescent lamps and six Jandus arc lamps. On the ground floor are fixed four 25-30 brake h.p. gas engines made by the Campbell Gas Engine Company, Ltd., Halifax. These engines have been specially designed for the driving of dynamos, with governors actuated direct from the crankshaft. Each engine has one large, heavy fly-wheel, weighing about two tons, and measuring 6 feet 6 inches in diameter. The engines are all arranged with their fly-wheels nearest the walls of engine room to allow plenty of room for the man controlling the plant. Each engine is fitted with a patent self starter. All the four engines can be got up to full speed within a quarter of an hour. The cooling of the cylinders is done from three rectangular tanks, having a total capacity of 3,600 gallons. A large main feed to the engines and one common return, to which each engine is connected, ensure a perfect cooling arrangement. The difficulty of space has been well got over in the arrangement of the water tanks. The exhaust of each engine is carried to the top of the theatre roof, about 60 feet high, with a 3½-inch pipe, and passed through an exhaust box and silencer, the noise from the exhaust being effectually silenced. These engines drive four shunt wound dynamos erected on the first floor immediately over the engine room, the arrangement of cross driving allowing 18 feet between engine and dynamo centres. The dynamos are driven by special laminated leather belting. Three are wound for an output of 145 amperes at 110 volts, and the fourth for 100 amperes at 150 volts. The average load of the installation is 500 amperes per hour for four hours at 110 volts. Therefore 55 x 4 equals 220 units per night; 220 x 6 equals 1,320 units per week. The gas for the four 25 brake h.p. gas engines passes through a 400 light meter; the gas consumption per night averages 7,000 cubic feet, and the Plymouth Gas Company's charge is at the rate of 1s. 9d. per 1,000; 7,000 at 1s. 9d. per 1,000 equals 12s. 3d. per night, or £3 13s. 6d. per week. The cost of production is therefore:

42,000 cubic feet of gas per week at 1s. 9d. per 1,000..	£3 13s. 6d.
Gas engine man's attendance at £1 5s. 6d. per week.	1 5s. 6d.
One dynamo attendant at £1 2s. 6d. per week.....	1 2s. 6d.
Oil, waste and engine sundries....................	12s. 6d.
For 1,320 units..............................	£6 14s. 0d.

From the above figures it will be observed that these large engines are working for 18s. 6d. per week each engine, or 1¼d. per unit."

—The New York Independent, the leading weekly newspaper of the world, and one whose pages exercise the widest influence, is entering upon its fiftieth year of publication The Independent emphasizes its fiftieth year by changing its form to that of a magazine, and by reducing its annual subscription price from $3 to $2; single copies from 10 to 5 cents. The Independent, in its new form, will print 3,640 pages of reading matter per year, at a cost to subscribers of $2, while the prominent magazines, which sell for $4 a year, print only about 2,000 pages. The subscriber to The Independent gets 82 per cent. more of equally good reading matter at one-

half the cost! It is not only the leading family weekly newspaper, but by far the cheapest and best. A free specimen copy may be had by addressing, The Independent, 130 Fulton Street, New York.

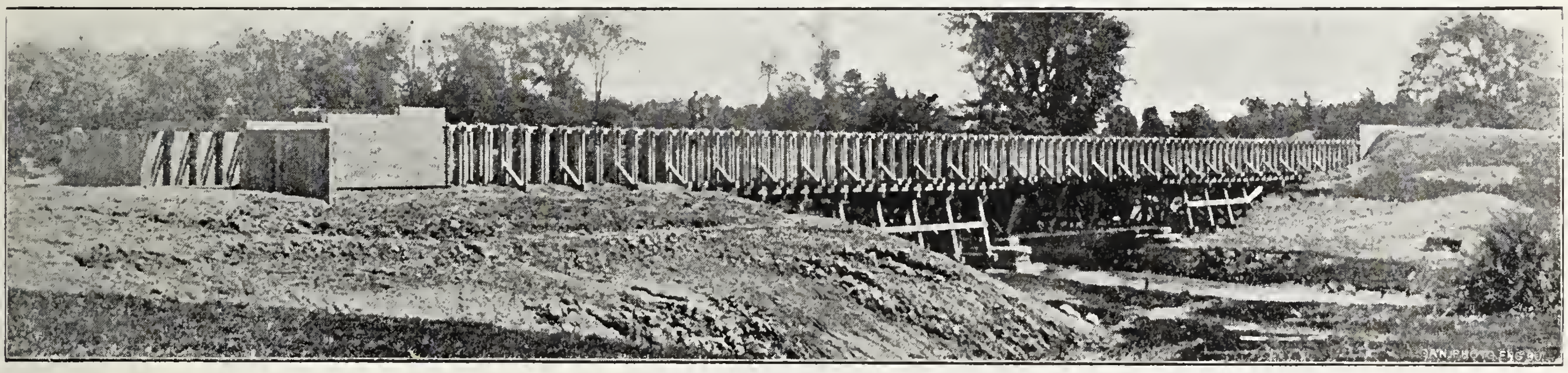
THE CATARACT POWER CO., OF HAMILTON, ONT., LTD.

Saturday, November 12th, will go down in the electrical annals of Canada as a red letter day, as it will chronicle the formal opening of the electric power plant of the Cataract Power Company, Hamilton, Ltd., for the transmission of electrical energy from a point on the Niagara escarpment, near DeCew Falls, to Hamilton, a distance of 35 miles, the conception and carrying out of which must always stand as a monument of the business pluck and enterprise to those interested in and forming the Cataract Power Company.

Over three years ago, when the transmission of energy by electricity over long distances for commercial purposes was still in much of an experimental stage, the possibility of utilizing the magnificent fall of over 200 feet, obtainable at DeCew Falls, where the waters of the Beaver Dams creek tumble over the Niagara escarpment, for the generation of electrical energy to be transmitted to the city of Hamilton, 35 miles distant, suggested itself to John Patterson of that city. After numerous surveys and examining into the physical feasibility of the scheme, he associated with himself the Hon. J. M. Gibson, John Moodie, sr., James Dixon and J. W. Sutherland, all well-known citizens of Hamilton. Together they procured a charter and formed the Cataract Power Company of Hamilton, Ltd., for the purpose of the development of this power and the transmission of it to Hamilton. After the formation of the company, the ground was again gone over carefully, and it was found advisable to abandon the original idea of utilizing the waters and water-ways of the Beaver Dams Creek and the DeCew Falls, and by changing the plans, some very material advantages were gained: The securing of a supply of water, which would be constant, through a feeder from the Lake Erie level of the Welland Canal at Allanburg; the construction of a canal, 4¾ miles long, over private right of way, thus giving the company an unobstructed water-way; the securing of land along the private water-way for storage basins, by which the company can conserve its water at a period of non-use or light load for use at the time of heavy load; and by going three-quarters of a mile east of DeCew Falls along the Niagara escarpment an additional fall of 75 feet was obtained, which was a very valuable acquisition. At this point there were also exceptional natural advantages, both at the top of the escarpment for the anchorage of flumes, erection of penstocks, etc., and at the foot of it, for the discharge of the tail water, as well as a splendid site for the power house.

The hydraulic development, as it was desired by the Cataract Power Company, presented obstacles which, owing to the large units and to the high head, made it exceptionally difficult to secure a builder of waterwheels who would give what the hydraulic engineer's specifications called for. After a long delay and much negotiation the Stillwell-Bierce and Smith-Vaile Company of Dayton, Ohio, agreed to build special horizontal turbines of a capacity of about 2,000 horse-power each, to work under a head of 275 feet, and to operate at a speed of 400 revolutions per minute. This required, also, special valves and valve gear, and controlling devices, all of which were specially designed for this particular plant. The generation of the electric power and the transmission of the same from the power house to the city of Hamilton, a distance of 35 miles, presented at that time a seemingly insurmountable obstacle to the carrying out of the scheme, no transmissions of energy, such a long distance, for commercial purposes, having up to that time been undertaken. The largest electrical concerns, both in Europe and America, were consulted, but the limitation of a practical working pressure, sufficiently great to insure the transmission of power such a long distance, practically precluded the undertaking of the work by any of the companies consulted, the highest working pressure, up to that time, being not above 10,000 volts. At this working pressure the cost of the transmission line became so great that the Cataract Power Company did not feel warranted to undertake the development of the enterprise. The longer the distance, the heavier the conductor must be; therefore, to transmit over this long distance, it was necessary that the pressure be 20,000 volts or over, so that the cost of the conductor would be within the limit set, of allowing the Cataract Power Company to undertake the development of the enterprise. After nearly a year of futile attempts to have the work undertaken at a pressure which would justify them in proceeding with the work, and being unsuccessful, they consulted J. A. Kammerer, one of the staff of the Royal Electric Company of Montreal, and after careful consideration of the conditions and preliminary estimates of the work being made by him, and a working pressure of 24,000 volts guaranteed, the Royal Electric Company agreed to undertake the work which, with its consequent saving, brought the cost within the limits deemed necessary by the Cataract Power Company to admit of their proceeding with the work.

The first ground was broken on October 5th, 1897, and the work was pushed with such vigor that the current was sent over the lines, from DeCew Falls to Hamilton, on the afternoon of August 25th, 1898, or just 10 months and 20 days from the beginning of work.



The Cataract Power Co.—Aqueduct over Beaver Dam Canal.

THE CANAL.

The water for this plant is secured through a feeder from the Lake Erie level of the Welland canal at Allanburg. The arrangement of the gates as shown in the illustration, is such as to admit of the unwatering of the lower levels of both the old and new Welland canals without interfering with the company's supply of water. From Allanburg the company has a private canal extending north-westerly to the edge of the Niagara escarpment, a total distance of about four and one-half miles. At three different points there are placed gates for regulating or shutting off the supply so that the water is under complete control. Where the canal crosses the Beaver Dams creek, the water is carried in a closed wooden flume supported on a steel truss. This flume is placed below the level of the water in the canal at each end so that the contained water is always under pressure, which is intended to prevent leakage. The water follows generally the water courses of a succession of small streams, consequently there are few heavy cuts or fills. In a number of places the contour of the ground formed a natural bed for the canal and no work was necessary. At the heavy cuttings, the banks to the bottom of the canal are pitched with stone and the important embankments are rip-rapped to prevent erosion.

At the lower end of the canal, near the mountain top, are located three large storage reservoirs, having a total area of thirty-three acres. These are sufficient to contain forty-eight hours' supply of water and will meet the hourly inequalities of demand usual in electric supply companies, as well as allowing the unwatering of the upper stretches of the canal for repair purposes, without the interruption of the service. Throughout the whole length, the work is of particularly substantial character, the factor of safety being exceptionally large, and all the requirements of the service seem to have been carefully considered. The large reservoirs being located immediately at the mountain's edge, where the water enters a steel pipe, and the long stretches of slow current canal, it is expected will promptly freeze over and prevent any trouble from frazil or anchor ice. In this matter the water power is particularly fortunate, as there is practically dead water to Lake Erie. The canal is designed to carry sufficient water to develop from 10,000 to 12,000 horse-power without creating an erosive speed in the current. The waterways and appurtenances were constructed under the supervision of Thos. E. Hillman, C.E., resident engineer, and under the general approval of Wm. Kennedy, jr., Montreal, engineer-in-chief.

THE PIPE.

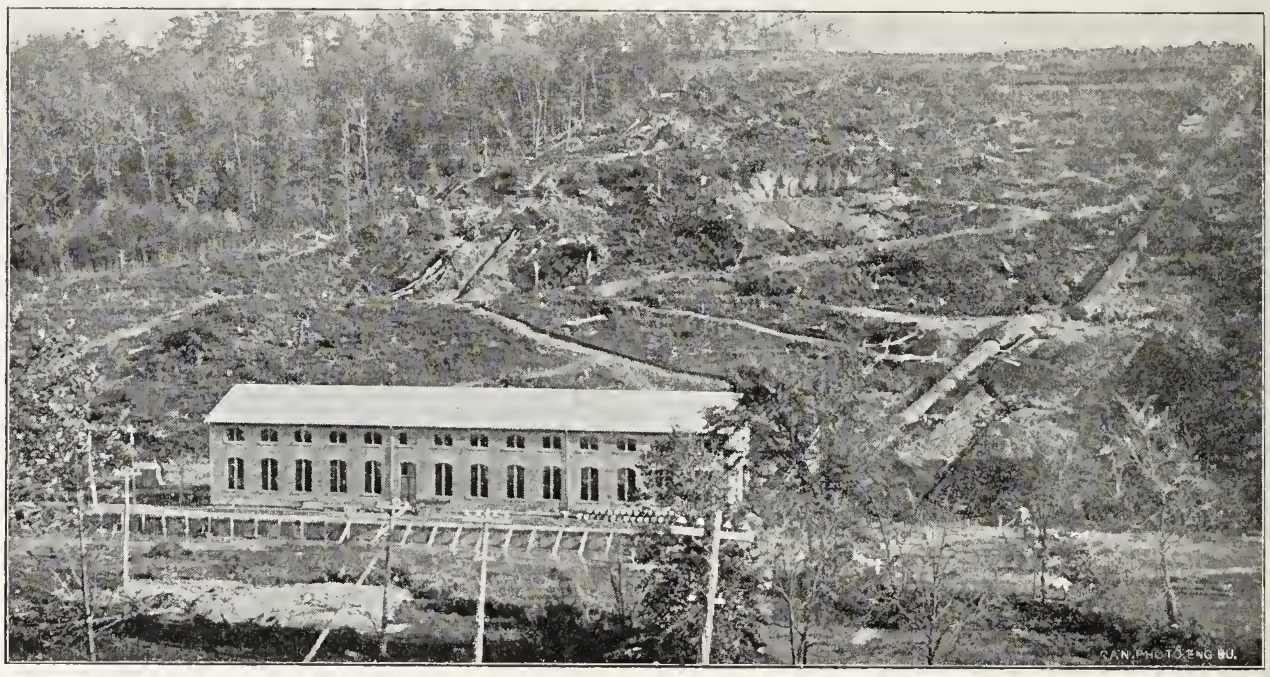
At the brow of the mountain, the water is delivered through a concrete fore bay, protected by suitable racks and head gates, to a large steel pipe which carries it directly down the mountain slope to the power house, 260 feet below. The pipe is of steel plate, double riveted on both longitudinal and transverse seams. It is 745 feet in length and varies in diameter from 8 feet 6 inches at the top to 7 feet 6 inches at the bottom. The steel used for the top section is ¼-inch in thickness and gradually increases in size down the slope until at the bottom it is 13-16 of an inch.

The weight of this pipe is all supported from the top, where a number of heavy flanges are built into several piers of concrete placed in the rock cutting. Down the slope, at intervals of fifteen feet, supporting masonry foundations are constructed. A substantial double housing of matched lumber is now being built over the entire length to protect the pipe from extreme changes of temperature. About two-thirds of the way down the slope is placed an expansion joint to take care of any elongation or contraction. In addition to serving this purpose, the joint is so designed as to support the part of the pipe below it. This is accomplished by means of the water pressure acting against an annular piston attached to the lower section, the piston working in a cylinder attached to the upper section. From the top the pipe runs downward at an angle of about twenty degrees for about two-thirds of its length, where it reaches a level bench about sixty feet wide, and then continues downward at the same slope to the bottom, where it turns with a gentle curve, almost a right angle, and extends underneath the floor of the power house.

POWER HOUSE.

The power house building is a substantial structure of iron and brick, 174 feet by 42 feet, with a galvanized iron roof over matched board sheathing. It is designed to accommodate four complete generating units, and the necessary step-up transformers, switchboards, etc. Only two units and half the capacity in transformers are at present installed. The building is lighted by clusters of incandescent lights, and will be heated by electric heaters. The main supply pipe enters at the end of the building below the floor level, and inside the building widens out into a steel receiver, ten feet in diameter, which is solidly imbedded in concrete underneath the floor. From this receiver four branch pipes come up through the floor, with a quarter turn for delivering water to the branches. In these branch supply pipes are placed the large vertical hydraulic gates, shown in the illustration. These gates are 36 inches in diameter, and are operated by hydraulic pressure by means of a four-way valve, controlled by a lever. These valves will open or close in less than a minute. The gates, as well as all the hydraulic machinery, were supplied by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio. Beyond each gate valve is placed a 12-inch spring relief valve, to relieve the pressure when it exceeds that due to the normal static head. The turbines are 1,950 h.p. each, and run at 400 revolutions under the normal head of 280 feet. The water wheels are of the inward flow central discharge reaction type with cylinder gates. We believe that this is the highest head employing this type of turbine, most of the high head plants using the jet or impulse, peripheral bucket design wheels. In order to withstand the unusual pressure, the runners, the gates and all parts susceptible to wear are made of bronze, and everything is made extremely heavy and has been specially designed for this plant. The water enters the wheel horizontally and discharges vertically downward through a draft tube 14 feet in height. Each unit is equipped with a Stillwell-Bierce & Smith-Vaile electric governor of the Giessler design for controlling the speed. On the outer end of the shaft is placed a 7½ ton steel fly-wheel with an outboard bearing. The combined influence of the enlarged receiver, the relief valves and the heavy fly-wheels are calculated to overcome any tendency to water hammer.

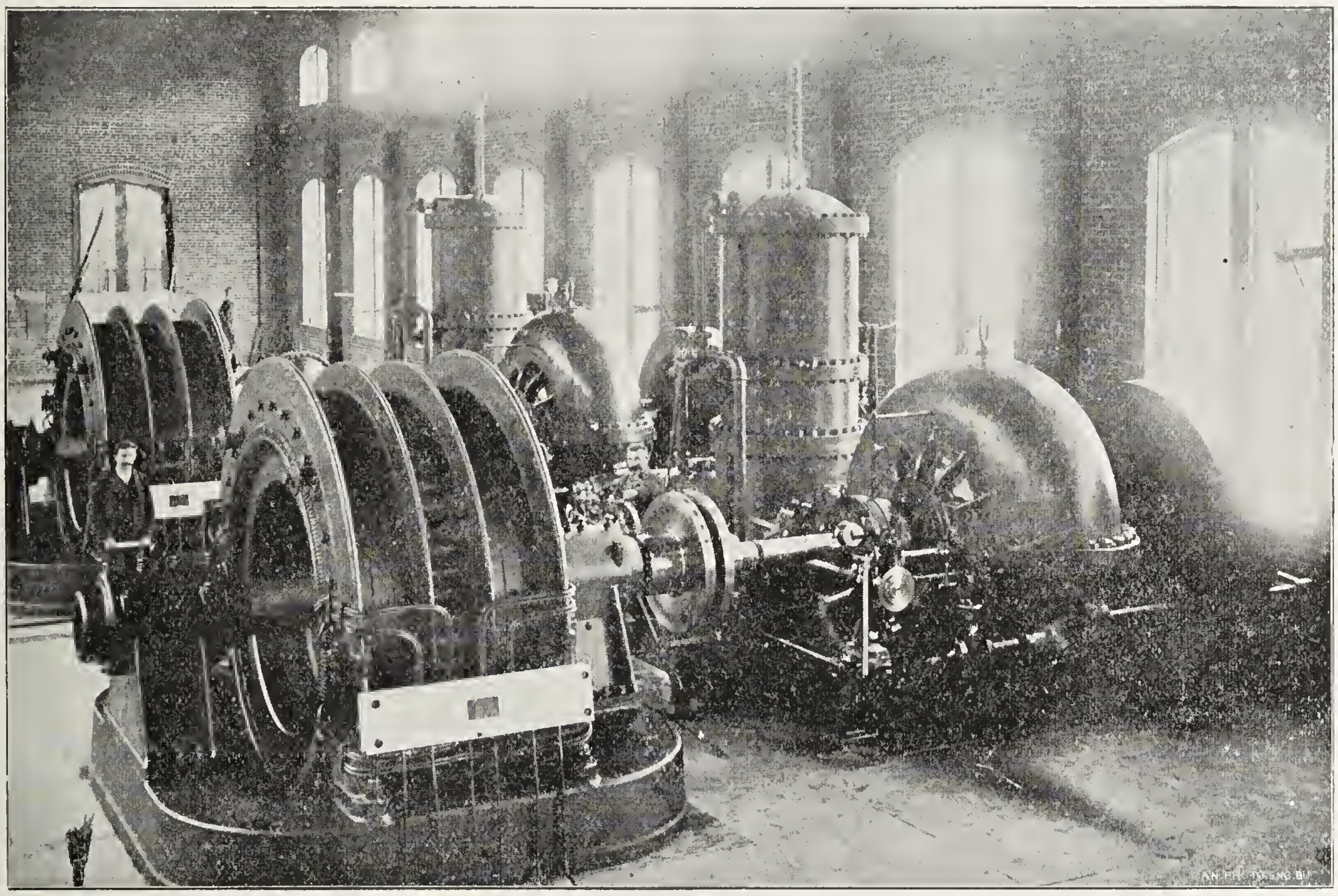
The entire electrical equipment was supplied by the Royal Electric Co., of Montreal. The generators are of their well known S.K.C. inductor type, generating two-phase current at 2,000 volts, running at 400 revolutions per minute. Each of the two generators at present installed is of 1,000 k.w. rated capacity. They are connected direct to the turbine shaft by means of an insulated flexible coupling composed of two flanges with projecting pins, the alternate pins being joined by sole leather links. The generators rest on base frames of seasoned Georgia pine to insulate them from the foundations. The stationary armature coils are wound of bare copper strip separated by sheet mica insulation. The inductors of these machines weigh over twelve tons, which weight running at such a high speed requires most careful workmanship. The entire absence of vibration and general smoothness of operation is certainly creditable to the manufacturers. The wires connecting the generators to the switchboard are laid in conduits in the floor, which are covered with iron girdles so that they are accessible at any point. There are two exciters of 30 k.w. capacity, each driven by a separate turbine. Each exciter is



The Cataract Power Co.—Power House and Pipe Line.

calculated for supplying the full equipment of four generators. They are likewise directly connected to and insulated from the turbines.

The main switchboard, as is shown in the engraving, is made up of three white marble panels, one for each generator and one for the exciters. On the generator panels all the connections are made on the back of the board, there being no terminals on the face. The switches are of the S.K.C. slide quick break type, and are provided with automatic shutters to prevent arcing. They are double throw, connecting to two separate sets of bus bars, so that the machines may be run on separate lines or in parallel, according to the future requirements of the service. Each generator panel contains a volt meter with a double throw switch connected to both phases, an ampere meter on each phase, and a direct current ampere meter in the filed circuit of the generator. The cases of the instruments are made of ground glass, and present a very attractive appearance. The exciter panel contains the usual instruments for operating two shunt-wound direct current machines in parallel and also contains the synchronizer, which is of the ordinary three lamp type. A special feature is the absence of generator fuses. As the S.K.C. generators supplied were made especially by the Royal Electric Co. to withstand a heavy overload, it was considered safer to risk the strain upon the generators due to a short circuit rather than by the blowing of generator fuses, to cause the instant removal of the entire load from the water wheels.



The Cataract Power Co —Generating Units in the Power House.

Immediately back of the switchboard and taking up one end of the building are located ten of a new type of S.K.C. transformers used to raise the potential delivered by the generators to 22,500 volts on the transmission line, at which pressure it is now operated. These transformers are arranged in batteries of five, each transformer having a capacity of 200 k.w. They are artificially cooled by means of water pipes supplied direct from the penstock, the pressure being reduced by means of throttle valves. The transformers are encased in tanks made of steel boiler plate, and rest directly on the concrete floor. The coils are wound in sections carefully insulated, and separated by unusually large air spaces, and the whole immersed in mineral seal oil. This construction has been found to admirably answer the purpose of this exceedingly high voltage, each transformer being tested with a break down strain of 40,000 volts before being installed. A novel feature of the installation, is the switchboards which accompany each transformer. They are of specially selected white marble, and contain two single pole high voltage switches, and one double pole 2,000 volt switch, the two high voltage switches being separated by a marble barrier. The high voltage switches consist of a flexible cable, having a screw plug attached to one end and a socket to the other, the socket being attached to a hardwood pole, four feet in length, for safe handling. The socket and the plug which it fits over are tipped with non-arcing metal. By means of these specially constructed switches the 22,500 volt circuit can readily be opened. The low voltage switches are of the S.K.C. slide quick break type on the back of the switchboard. Each transformer is also equipped on both the primary and secondary sides with enclosed non-arcing fuses

The 22,500 volt wires inside the building are all covered with a specially heavy insulation of rubber, and are supported on porcelain line insulators on an overhead rack, all being in plain sight and easily accessible. From the transformers, which are connected five in parallel on each phase, the circuit runs to the line terminal board, consisting of four high voltage switches similar to those placed on the transformer, except that they have double terminals, in order that they may be changed to either of the two lines contemplated by the company. Immediately above the line terminal board is placed a specially constructed lightning arrester equipment composed of 60 S.K.C. non-arcing arresters with their special appurtenances and connections. From the lightning arresters the wires pass upward and out through the wall of the building at a height about 30 feet from the floor.

THE LINE.

The high voltage wires are carried through the brick wall forming the gable end of the power house, by means of lead encased rubber covered cable, protected by vitrified pipe, the cable being kept clear of the pipe by wooden bushings specially prepared in oil. After passing over a crossarm attached to the building, the lead covered cable is joined to the bare copper transmission wires, by means of a long, carefully made waterproof joint. This special construction has proved entirely satisfactory. From the power house the transmission line crosses the Twelve Mile creek, and runs up the hill opposite, on private property, to a concession road, thence along this roadway due north to the Grand Trunk railway, and then westward along the railroad right of way on an almost perfectly straight line to the company's step-down station at Hamilton, a total distance of a little less than 34 miles. The transmission wires are four in number and are No. 1 B. & S. medium drawn bare copper. They are all placed on one four pin crossarm 3¾ feet by 5¾ feet, spaced 18 feet apart, and are supported on porcelain insulators of the Redlands type, supplied by the Imperial Porcelain

Company. The pins are of special design, holding the insulator two inches higher from the crossarm than the standard practice. This is to avoid trouble from heavy snow or sleet. The pins are of yellow locust, specially prepared in oil, and are fastened into the crossarm with a wooden pin instead of being nailed, so as to use as little iron as possible. The poles are all specially selected with 8 inch tops and not less than 35 feet in length. They are set 90 feet apart and 6 feet deep in the earth. The height of the poles varies with the contour of the ground, so as to keep the wires as nearly horizontal as possible. In marshy places a crib filled with stone is built around the base of the pole, and where the line crosses the Jordan river, the poles are placed in a cluster of piles specially driven for the purpose. On the top of the poles is run a galvanized iron barb wire grounded at every pole by means of an iron plate for lightning protection. Below the transmission crossarm is placed a two-pin crossarm carrying the telephone circuit. The telephone circuit is a complete metallic circuit of No. 10 B.W.G. galvanized wire, transposed at every fifth pole. This arrangement has been found to give satisfactory service with the heaviest currents yet passed over the line. The insulators were all carefully tested with a breakdown pressure of 60,000 volts, both at the factory and again at Hamilton before being put up, with the satisfactory result that not one has broken down, or produced the slightest trouble in the three months during which the line has been in operation, notwithstanding the unusual rain and sleet storms during that period. The construction of the pole line was done by Lowe & Farrell, of Hamilton, the Cataract Power Company supplying the material. This work has been executed in a very creditable manner.

The Cataract Power Co.—Water Wheel Line.

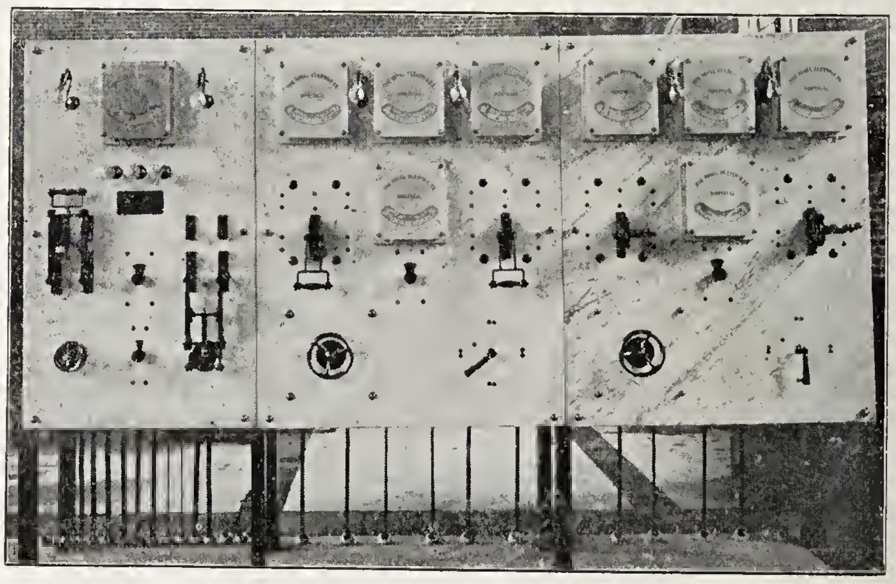
Cataract Power Co.—In-take at Allanburg.

TRANSFORMER SUB-STATION AT HAMILTON.

The company's step-down station is located at Victoria avenue, immediately beside the Grand Trunk railway's right of way, about one mile within the city limits. It is a neat structure built of brick with a slate roof and specially designed for this purpose. At this point the voltage is reduced to 2,000 volts, at which pressure the current is distributed through the city in four separate circuits. The line wires are carried through the brick walls of the building in the same manner as at the power house. There is the same arrangement of lightning arresters, high voltage lines and two batteries of transformers. The transformers, however, are arranged so as to be artificially cooled at times of heavy load by means of an air blast. The transformers rest over an air duct in the floor, and are provided with a ring of vertical air ducts, passing up through the oil. The blast arrangement, which consists of a No. 6 Sturtevant Blower, direct connected to an S.K.C. two-phase induction motor, delivers air directly into this duct, which then passes upward through the transformers. In the transformer room is also placed the distribution switchboard, and, as at the power house, only half the ultimate capacity of the transformers has been installed, the building being designed to accommodate two more batteries of five, similar to those already placed, consisting of four panels each, containing two ampere meters, two double pole double throw switches, and four duplex fuse blocks. From this distribution switchboard incandescent lighting current is supplied for the Hamilton Electric Light & Power Company, as well as for motors on premises of customers throughout the city. From the switchboard the circuit wires pass upward to a cupola in the roof at which point they are joined to the distribution circuits. The line supplying the incandescent service is a four wire two-phase circuit, but the circuits devoted exclusively for power, are composed of three wires only.

At the premises of the Hamilton Electric Light & Power Co. is being installed a new circuit switchboard arranged to accommodate the old single phase lighting circuits of this company. Each circuit is equipped with a double throw switch in order that the load may be divided with a regulating transformer in order that the pressure may be controlled from this point. The old house to house 1,000 volt 16,000 alternation transformers have all been replaced by new S.K.C. 2,000 volt 8,000 alternation transformers in larger units, and the service all changed to this higher pressure in order to reduce the losses and obtain better regulation. In addition to supplying the Hamilton Electric Light & Power Co.'s service, the Cataract Power Company has already contracted for a large amount of power for operating factories of different kinds in the city. They expect within a short time to supply the various electric railways in and about Hamilton, and to replace nearly all the steam engines in the various manufacturing establishments with electric motors.

The plant has been in practical operation for several months, and has thoroughly demonstrated the success of electrical transmission at this high voltage and long distance, which speaks well for the carefulness in designing and construction of the work. The officers of the company are: Hon. J. M. Gibson, president; John Moodie, treasurer; John Patterson, secretary; H. R. Leyden, general manager, the latter having had general charge of all the construction operations.



The Cataract Power Co—Generator Switch Board.

INAUGURATION.

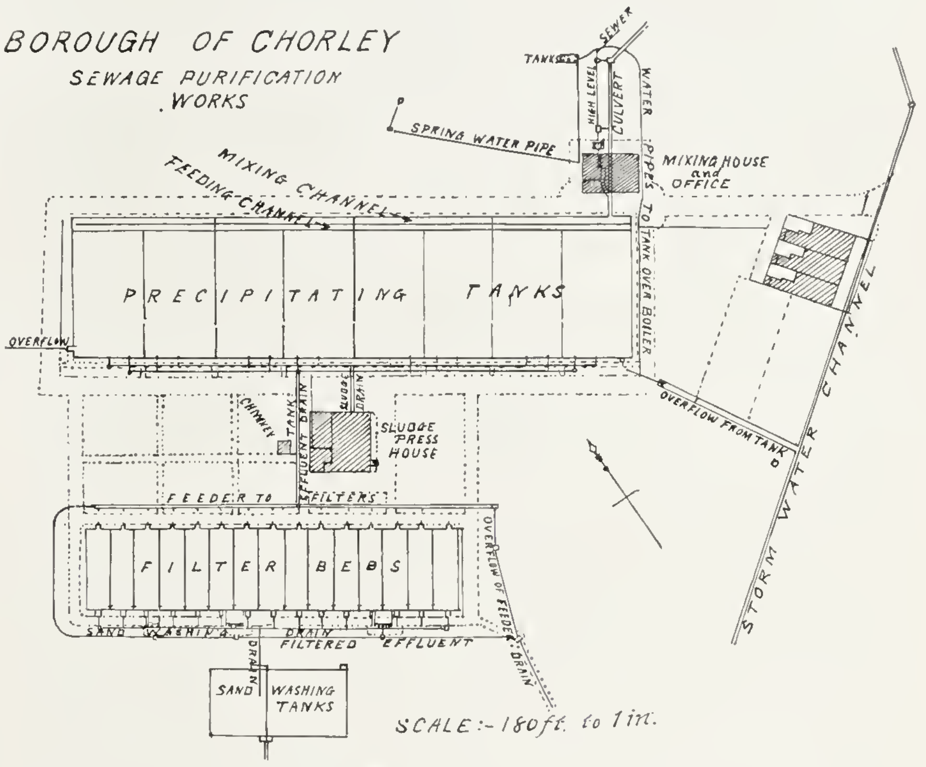
The formal inauguration of the Cataract Power Co., of Hamilton, Ltd., plant at DeCew Falls and Hamilton, Ont., took place on Nov. 12th, when a large company from Toronto, Hamilton and the surrounding towns and cities enjoyed the splendid hospitality of the company. The party left the Grand Trunk station, Hamilton, at 12.30 and went to St. Catharines, from which carriages were provided to DeCew Falls. Among those present were: Hon. J. M. Gibson, president of the Cataract Power Company, Mayor Colquhoun, Ald. Carscallen, M.P.P., A. T. Wood, M.P., T. H. MacPherson, M.P., Adam Brown, J. Turnbull, City Solicitor Mackelcan, John Patterson, John Moodie, Reginald Kennedy, H F. Gardiner, Ald. Metherell, Dr. Osborne, George Tuckett, H. H. Witton, E. B. Wingate, Chester Fearman, Robt. Thomson, A. F. Pirie, of Hamilton; J. J. Wright, E. H. Keating, City Engineer Rust, Assistant City Engineer Fellowes, A. E. Osler, W. H. Maclean, M.P., and others, Toronto.

When the power-house was reached the machinery was found running at full speed, and the whole plant going in marvelously fine shape. The visitors spent an hour in inspecting it. After that a splendid luncheon was partaken of. The chairman, Col. Gibson, proposed the health of the Queen and Parliament. Congratulatory speeches were made by A. T. Wood, T. H. Macpherson, William Gibson (Lincoln), W. F. Maclean and A. F. Pirie. John Moodie and John Patterson also spoke. The train was then taken for Hamilton, where the transforming station was visited. The day was a success from every standpoint both as a successful inauguration of a magnificent plant and as a most enjoyable social event.

THE CHORLEY, ENGLAND, SEWAGE WORKS.

The following is an abstract from the description of the method of sewage purification in use at Chorley, Eng., which was submitted to the Toronto city council by Ald Hallam on his return recently from England: The inlet channel of the sewage from the town leads to a catch basin or pit, the object of which is to catch the detritus, such as road scrapings, sand or gravel and heavy material generally, which will not float, and thus to prevent objectionable materials going into the precipitation tanks, where it would have to be taken out and pressed at much cost. Formerly in case of storm the sand, etc., from the roads washed into the tanks in cart loads. These catch pits are cleaned out about once a week. Some of the storm water comes down here, but most of it goes through the storm water channel, in fact the River Committee of the county council permits, when the flow is three times the normal quantity, to send it direct to the river. This, however, does not often occur, and when it does it is only for a limited period.

The sewage after passing over the catch pit passes through a screen to which is attached a rake or scraper. This scraper is driven by a water wheel, which is worked by a flow of sewage brought to a higher level. The object of the scraper is to keep the bars of the screen free from refuse which has not precipitated when passing over the catch pit, for example, corks, wood, paper, and other floating bodies. From here the sewage flows into the main distributing channel, but before it got there the precipitant (ferrozone), is added in proportion of from 10 to 14 grains per gallon, according to the foulness of the sewage. The quantity of the precipitant is left to the discretion of the man in charge of this part of the works, as it cannot be done automatically. He continually tests the sewage throughout the day, because it varies almost from hour to hour. Comparatively little ferrozone is required during the night time. In addition to the main flow over the catch pit we have a higher level flow, which is brought up under pressure in order to work the water wheel, which is used for two purposes: 1st. For turning the screening arrangement as before stated, and thus saving expense in the generation of steam, and 2nd. For pumping water from a well of spring water, into two large iron cisterns, which are used to supply drinking water to the cottages of the workmen, and also to provide water for the steam engine boiler attached to the steam engine in the press house. If there were a larger flow of sewage and the gradients were right, it would be quite possible to get all the power required from the large water wheel driven by the sewage itself. But the fall in the land sewer is not sufficient. In the mixing room there is an arrangement for mixing the ferrozone with the sewage. The sewage water is diverted from the pipe which turns the water wheel and proceeds underneath the bottom of the tanks, and as it enters these receptacles it takes up particles of ferrozone, making a solution of ferrozone and sewage water, which is mixed by a vertical agitator in each of the tanks, from this the mixed sewage floats into the main distributing channel, which runs the whole length and back again of the eight precipitation tanks. These tanks have a capacity of 140,000 gallons each, the dimensions will be seen from the plan. Each tank contains from six to seven feet of sewage water. The distribution channel is furnished with both side and baffle plates to assist in the thorough mixing of the ferrozone with the sewage water. In Chorley they are just undergoing a change from the pail to the water carriage system. In the collection of the pails there is spent £1,400 a year, and the contents of the pails are poured into the sewer "en masse." As these pails are only collected weekly, secondary decomposition is set up, and the treatment of the sewage rendered more difficult than would be the case if water carriage were the rule instead of the exception.



Chorley Sewage Disposal Works.

It is for this reason that the amount of ferrozone varies from 10 to 14 grains per gallon, if the condition of the sewage was normal, the probability is that 10 grains of ferrozone per gallon would be ample. The mixing channel runs the whole length of the tanks and parallel to them, and leads to the channel which feeds each of the eight tanks. The mixed sewage is allowed to remain in the tanks until such time as in the judgment of the man in charge it is in such a state of precipitation as to be allowed to go into the filters. The time of precipitation varies from two to five hours.

Each of the precipitation tanks is provided with two valves; one for liberating the semi-pure sewage water and the other for liberating the sludge. When as much water as can be drawn from the tanks has been taken, the sludge valve is opened; the man then goes into the tank and removes the sludge at the bottom of the tank towards the valve. There is a fall in the bottom of the tank, and also a fall in the sludge channel to the wall underneath the press house. From this well the sludge is forced up into the press by means of compressed air at a pressure of from 75 to 95 pounds per square inch, water to the extent of 90 per cent. of the sludge is extracted by pressing, leaving a sludge cake 35 to 40 per cent water. The valve which liberates the water which then goes to the filters is provided with a floating arm, the use of which is to prevent the floating scum from going into the filters. The purpose of this is to get the water into the filters as pure as possible. When the water leaves the precipitation tanks it is brought down a central channel, and then diverges to the right and left in a distributing channel, which runs parallel to the fifteen filters, which constitute the system.

Each of these filters has a superficial area of 100 square yards. The system in vogue at Chorley is on the intermittent principle, that is, from two to three inches of sewage water only is allowed on the surface of the filter, these two or three inches are allowed to gravitate through the filter, a process which takes from 30 to 40 minutes, and at the expiration of that time a further flow is put in the filter. The object of the intermittent flow is to provide that the sewage water as it passes through the strata of the filter shall draw air after it. By so doing, the interior of the filter may be said to be purified every time it is used. Each filter has a channel down the centre (on the surface), a perforated wooden trough patented by the chairman of the sewage works committee. The trough is 6x6 inches, and it has three rows of perforations; the object being to equally distribute the water over the surface of the filter without disturbing the top strata (sand), it also helps to oxygenize the sewage water. By this means the water can be placed in the filter at least three times as quickly as when the ordinary iron trough is used. In the latter case the water as it flows from the trough continually stirs up the sand with the effect of mixing the clean and dirty sand together, thereby making the washing of the filters much more expensive. It is contemplated to flush the filters automatically by means of a syphon attachment. The water having passed through the filters, which are arranged in triplets, goes into the river, along an outfall channel, having the appearance, smell and taste of spring water; in fact so pure is effluent, states the report, that a tank has been constructed in which gold fish have now lived for over six months.

The next process is washing the filters. The whole of the filters are washed every week, three per day, the remaining time of washing is used in cleaning the various channels, in fact, one of the great secrets of the success of the works after the construction, must be attributed to the cleanliness of everything about the place. For precipitation works to do their work properly it is absolutely necessary that all channels, except sludge channels, be continually washed out, the filters are washed by means of an upward flow as follows: Two of the filters are filled with effluent from the precipitation tanks, the water filters through each of these and ascends as filtered water into the third, which has to be washed. When the water makes its appearance in the third filter, the washing men, who are provided with waterproof boots, go into it with rakes and brushes and thoroughly agitate and disturb the surface of the sand, which the percolation of the water from the other two filters into the third readily allows them to do, the object of this is to take out an amount of suspended matter which has been left in the filter by the sewage effluent in its progress through the filters. This impurity generally penetrates three inches from the top of the bed, and the work of the filter washers is not complete until the whole of the impurity is comparatively speaking, removed. Whilst this work is going on, the penstock at the bottom of the filter to be washed is opened, in order that the polluted water, the product of the water which has come out of the other filters, and the suspended matter in the sand at the top of the filter under course of washing, may flow through this sand washing water, then proceed down a central channel provided with catch pits to intercept any sand which may be escaping, in order that it may be washed and put back again into the filters into two tanks, whence again it flows by gravitation to a well near to the press house, where it is pumped into the precipitation tank for retreatment; the four inch pipe which conveys the sand washing water goes underneath the filters. The pump has a capacity of 20,000 gallons per hour.

Where lime is used as a precipitant there is a tendency to secondary decomposition. The cost of the precipitant ferrozone is 40s. per ton. Without the intermittent flow it would be absolutely impossible to get the purity of the effluent that is secured at Chorley, the report states; the watershed committee insists upon a certain standard of purity, and it is secured by means of the intermittent system of purification. The cost of the Chorley works is about £18,000. The filters have each 3 feet 1 inch of material. The top strata is composed of fine sand from Fleetwood Harbor. The second of sand and polarite mixed in the proportion of 6 inches polarite and 5 inches sand. The next layer is composed of finest gravel and then follow in rotation pea, bean and walnut gravel, and at the bottom, small boulders.

Population of Chorley, 26,000. The quantity of sewage treated daily varies from 750,000 to 1,000,000 gallons. The crude sewage contains from 3 to 5 per cent. of albuminal ammonia. The purified effluent contains .036 to .075 per 100,000 parts.

MECHANICAL DRAFT FOR STEAM BOILERS.*

BY WALTER B. SNOW.

The first requisites for the successful combustion of fuel are the supply and proper distribution of a sufficient amount of air. To insure the fulfillment of these requirements in steam boiler practice, draft is necessary and the force of the draft must be expended in two ways. First, a portion is necessary to overcome the resistance of the grate and the fuel upon it, or the combustion chamber, flues or tubes and uptake, and of the means of connection to the source of draft, be it fan or chimney. The sum of these resistances is a measure of the pressure head. Second, the draft must, in addition, be sufficient to impart to the air the necessary velocity to furnish the amount requisite for the direct purposes of combustion. This is a measure of the velocity head. With a constant total head any change in the resistances immediately alters the relation between the pressure and velocity heads. Professor Gale found, in the case of a stationary boiler furnace of ordinary construction, that only about 4 per cent. of the total draft pressure was actually expended for the production of velocity, and the movement of the air. Therefore, designs for draft-producing apparatus must first contemplate the creation of sufficient intensity of draft to overcome all resistances, and then provide capacity for the necessary amount of air.

In the case of a chimney, the maximum draft, being dependent upon its height, is constant for the same temperature, and regulation of the combustion can only be secured by throttling the air supply. With a fan, however, the intensity of the draft may be instantly changed from zero to the maximum with a proportional increase in the air volume. Properly, the draft to be determined in practice is that relating solely to the supply of air to, and the overcoming of resistances in, the fire. This is obviously the difference between the over and under-grate pressures. Approximately, the volume of air supplied (for equal temperatures) is an index of its velocity and varies directly as the square root of the effective pressure or draft. Conversely, the required draft will vary as the square of the rate. The chimney has long stood as practically the only available means of producing draft, which, thus produced, has commonly been called "natural draft." Primarily introduced for the purpose of increasing the rate of combustion, artificial draft was designated as "forced draft." Artificial draft may be produced by means of steam jets inducing a flow of air, by blowing engines, by air compressors, by positive rotary blowers and by fan blowers or exhausters. The fan has, however, become the accepted symbol of artificial, or mechanical draft, and is to-day the accepted substitute for the chimney.

Two types of fans exist. The first, known as the disc or propeller wheel, is constructed on the order of the screw propeller and moves the air in lines parallel to its axis. It is practically valueless for draft production. The second, or fan blower proper, consists in its simplest form of a number of blades extending radially from the axis, and presenting practically flat surfaces to the air as they revolve. By the action of the wheel the air is drawn in axially at the centre and delivered from the tips of the blades in a tangential direction. This type may be simply designated as the centrifugal, or peripheral discharge fan. The degree of vacuum which may be produced at the inlet, or of pressure which may be maintained at the outlet, of a fan of this type, is dependent upon the circumferential speed of the wheel; and the velocity of the air discharged through an outlet of proper size is substantially equal to that speed. If the fan be allowed to discharge the air through a short and properly shaped outlet, the pressure created will, with an efficient fan, be substantially that required to produce the velocity. The relation between the velocity and the pressure or head is expressed by the well-known formula for falling bodies, namely—

$$V = \sqrt{2gh}$$

in which the head "h" is equal to the pressure divided by the density of the air. From this basis formula it is evident that the pressure created by a given fan varies as the square of its speed. The volume of air delivered is, however, practically proportional to the speed. The work done by a fan is represented by the distance through which the total pressure is exerted in a given time. It varies as the cube of the velocity; that is, as the cube of the revolutions of the fan.

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*Abstract of a lecture delivered before Sibley College, Cornell University.

The ordinary barometric and hygrometric changes in the atmosphere have no appreciable effect upon the pressure and power. But the density varies inversely as the absolute temperature, and, therefore, should enter as a factor even in calculations with reference to air at or about ordinary atmospheric temperatures, and must be taken into account when heated air or gases are handled. In the design of a fan wheel to meet given requirements it is necessary to make its peripheral speed such as to create the desired pressure, and then to so proportion its width as to provide for the required air volume. If possible a fan should never be made so small that it is necessary to run it above the required pressure in order to deliver the necessary volume. To double the volume under such circumstances requires eight times the power; three times the volume demands twenty-seven times the power.

The chimney as a means of creating a movement of air depends upon the heating of that air, by which a difference in density is produced. The heat thus employed is, however, absolutely wasted, so far as its utilization for any other purpose is concerned. This inherent loss with an ordinary coal actually amounts to about 20 per cent. when the gases are at 500°, and the excess of air is 100 per cent. Heat being the agency by which the air movement is brought about, the efficiency of a chimney must be measured by the amount of heat expended for this purpose. As heat is transformable into work, the efficiency is therefore to be measured by the number of foot-pounds of work represented by the pressure difference exerted through the distance moved, as compared with the number of foot-pounds represented by the total amount of heat expended.

It may be shown that when no work is lost in friction and the respective temperatures of the external air and the chimney gases are 62° and 500°, the theoretical efficiency of a chimney 100 feet will be only about six ten-thousandths.

If in the place of the chimney there be substituted an engine-driven fan of proper size, the resultant of the efficiencies of the steam boiler, the engine and the fan, together with the loss by friction in the apparatus, may be reasonably taken at about 4 per cent. Therefore, the work done, or its equivalent in heat units expended to produce the given result will be about 70 times as great in the case of a chimney as in that of a fan. All other questions aside, the fan is, therefore, far more economical than the chimney. This economy means that when a fan is employed, the surplus heat can be utilized and the gases reduced to a minimum temperature before they escape.

The methods of application of mechanical draft may be broadly classified under two heads—the plenum and vacuum methods. Under the plenum or "forced" draft method the air may be supplied in either of two ways. First, by making the ashpit practically air tight, and forcing the air into it. Second, by making the fire room itself practically air tight and maintaining therein the required air pressure. Under the vacuum or "induced" method there is practically only one means of application—that by the introduction of an exhausting fan in the place of a chimney. A short and comparatively light stack usually serves to carry these gases sufficiently high to permit of their harmless escape to the atmosphere.

The application of mechanical draft presents a three-fold opportunity for increased economy in steam production; first, in the reduction of avoidable losses, second, in a decrease in the first cost and resultant fixed charges on the entire generating plant, and third, in a reduction of the operating expenses, chief among which is the cost of the fuel. In addition, mechanical draft possesses certain advantages which cannot be directly measured in dollars and cents; such are its peculiar adaptability to the requirements, its independence of climatic conditions, its flexibility and the like.

The losses which are more or less avoidable are: First—Those due to incomplete combustion, as usually evidenced in the presence of smoke and carbonic oxide in the flue gases and in unconsumed coal in the ashes, as well as to a small amount of hydrogen or marsh gas which may pass out with the gases. Second.—Loss from excess of air, due to the fact that to secure practically perfect combustion, air is usually supplied in excess of the theoretical quantity chemically required for combustion. This loss is two-fold, being dependent upon the quantity of unused oxygen and associated nitrogen and upon the moisture in the air. Third.—The loss resulting from too high temperature of the gases leaving the boiler. This loss, except in so far as it is influenced by the air supply and the rate of combustion, is dependent upon the design of the boiler and its appurtenances, and, therefore, is not chargeable to the character of the fuel. It is one of the most important factors in fuel efficiency. Fourth.—Loss of heat by removing ashes at too high a temperature. This, by care, may be reduced but not entirely avoided. Fifth.—Loss by radiation. This may be reduced by increasing the thickness of walls and covering all exposed portions of the boiler. But from a practical standpoint it can never be entirely avoided. The presence of smoke indicates an absolute loss. Although this seldom exceeds 1 per cent. in ordinary practice, even this amount may be almost entirely eliminated and the smoke nuisance may, in most cases, be practically avoided by such regulation of the air supply and the intensity of draft as is possible under the conditions of mechanical draft. The loss of efficiency which ensues from the escape of carbonic oxide unconverted into carbonic acid is due to the much smaller amount of heat given out upon the incomplete combustion of carbon into the former gas. When a fire is suddenly thickened and deadened by additional coal, and large volumes of gas are given off, there is a demand for an increased air supply for the purposes of combustion. At the same time there is a tendency to clog the passages through which the air has previously passed, and thereby to prevent complete combustion at the surface of the fire. At this time, for perfect conditions, more air under greater pressure should be admitted, as is possible under the positive action of mechanical draft. The relative amount of unconsumed coal in the ashes is dependent upon the completeness of combustion and upon the original size of the coal or its tendency to decrepitate as well as upon the size of the free spaces through the grates. It has been conclusively shown that fine fuels can only be successfully burned upon special grates with an intensity of draft such as can be most economically produced by mechanical means.

A most important advantage of mechanical draft is presented in the opportunity which it affords for the proper regulation of the air supply. A certain amount of air is usually necessary for the purposes of dilution, but an unnecessary excess is productive of one of the greatest losses incident to steam generation. Theoretically, the amount of air chemically required for the combustion of one pound of coal is about 12 pounds. Donkin and Kennedy have shown by gas analyses that, in the case of 16 different plants, the air supply ranged between 56 per cent. and 328 per cent. in excess of the chemical requirements. If the air be supplied in excess of that necessary for perfect combustion, there is a definite loss, disregarding that due to moisture in the air, which is two-fold in its character: First, the excess of air entering the furnace is heated by the burning fuel, thereby lowering the temperature of the mixture of gases and air below that which would prevail if the gases only were present. As a consequence, the rate of absorption of heat by the water is reduced, for it is dependent upon the difference in temperature between the water and the gases. Second, owing to larger volume and higher velocity, there is less time to part with the heat and the temperature of the mixture of gases and air escaping to the chimney is higher than would be the case if there were no excess of air; while the increased volume is such that the total amount of heat thus carried away, without exerting any useful effect, is greatly increased. In other words, paradoxical as it may seem, the larger the volume of air supplied, the higher will be the temperature of the escaping gases.

A high furnace temperature and low stack temperature, other things equal, are evidently conducive to greater efficiency. It has just been shown that such conditions are incident to a reduction in the excess of air supplied. With a decreased supply of air, the intensity of the fire is increased, its temperature is higher, more heat is radiated to the exposed boiler surfaces, and more is taken up by the gases. Furthermore, the diminished superficial area of the grate and of the exposed interstices between the fuel necessitates a higher velocity to secure the admission of a given volume of air. This increased velocity in turn requires greater draft or air pressure, which may be most readily produced by mechanical means. If a given grate be reduced one-half, and the rate of combustion be doubled, the same volume of air would have to travel through the exposed interstices at twice the velocity. But the pressure or vacuum required to produce this velocity would be four times as great, and, as a consequence, the air would be forced or drawn into spaces between the fuel which it could not reach under lesser impelling force. Much more intimate contact and distribution are the results. Less free oxygen passes through the fuel bed unconsumed, and for a given supply of air a higher efficiency of the fuel is attained. In experiments with a Wilkinson stoker, Witham has shown the most remarkable result of almost perfect evaporative efficiency with a combustion rate of 45.4 pounds and an actual deficiency of 11.2 per cent. in the air supply below the chemical requirements.

Undoubtedly the source of the greatest loss in boiler and fuel efficiency lies in the usual high temperature of the escaping gases. In seventeen independent boiler tests, Donkin and Kennedy found the heat lost up the stack, when no economizer was used, to range between 9.4 per cent. and 31.8 per cent. of the total heat of combustion. With the chimney a comparatively high temperature of the rejected gases is an absolute necessity to the production of the draft. Its production by means of a fan is, on the other hand, independent of the temperature of the gases, and there is, therefore, presented the opportunity to utilize the heat which is a positive and unavoidable loss in the case of a chimney. It is usually customary to abstract the surplus heat from the gases by some means in a sense independent of the boiler, such as a feed-water economizer, or a device for transferring the heat from the gases to the air supplied to the fuel, or both. Roney has shown in the case of nine boiler plants equipped with economizers and mechanical draft, an average fuel saving of nearly 14 per cent. of the total calorific value of the coal. With the Marland type of air heater, Hoadley reduced the total waste in the flue gases to only 5 per cent. of the calorific value of the fuel, and required only 1 per cent. of the total steam generated to operate the blower employed to produce the necessary draft.

(To be continued).

THE MANUFACTURE OF CARBORUNDUM AT NIAGARA FALLS, ONT.

The development of this new industry belongs to Niagara Falls, on both sides of the river. Not very long ago, the first kiln of carborundum ever made in Canada, and the second instance of its manufacture in the whole world, was opened in Niagara Falls, Ont. As yet the extent of its manufacture is not adequate to the number of uses that will create a demand for carborundum, and in a short time it is expected that the output will be very large in view of the rapid growth of its use in all work that requires an abrasive.

The first carborundum furnace consisted of an iron bowl lined with carbon, and a carbon rod; a mixture of clay and carbon was introduced into the bowl, and the rod placed in the mixture. A current sufficient to fuse the mixture, or at least to bring it to a very high temperature, was then passed through the furnace, the iron bowl and carbon rod serving as terminals or electrodes. When the current was cut off and the furnace had cooled down, it was opened, with the result that a few bright blue crystals were found surrounding the carbon rod. The furnaces constructed after this first experiment approached more nearly in form the furnaces in use today. They were built of brick, their internal dimensions being ten inches in length, four inches in width, and four inches in depth. The terminals were a pair of carbons, which could be moved longitudinally, thus permitting the distance between them to be altered at pleasure. These were essentially arc furnaces, that is to say, the idea was to form an arc between the terminals and to bring about the necessary chemical changes by the high temperature thus produced. Mr. Acheson, the patentee, soon found, however, that this method of working was not satisfactory, and he then set about constructing the incandescent furnace, which is the kind that is used to-day.

The crude materials for the manufacture of carborundum, viz.: sand, coke, sawdust, and salt, are received in the stock building. These are ready for immediate use. The coke must be reduced to kernels of a certain size to be used as "core," and ground to a fine powder to be used in making the mixture or charge for the furnaces. The furnace room is built to accommodate ten furnaces, though at present there are but five. The furnaces are built of brick, and have the form of an oblong box, the internal dimensions being approximately 12 feet in length, 3 feet in width, and 3 feet in depth. The ends are built up very solidly with a thickness of about 1½ feet. In the centre of either end are the terminals, consisting of 16 carbon rods, 20 inches long and three inches in diameter. The outer ends of the carbons are closed in a square iron frame. Finally, all the space between the inside of the plate and the ends of the carbons is tightly packed with graphite. Each plate is provided with a projection, to which the cables conveying the current may be bolted. These ends are the only permanent parts of the furnace.

The current, as supplied from the Niagara Falls Power Company, has a voltage of 2,200, and to use it in the furnaces it is transformed to a lower voltage.

After the circuit has been closed in the transformer room, no apparent change occurs in the furnace for about half an hour. Then a peculiar odor is perceived, due to escaping gases, and when a lighted match is held near the furnace walls, the gas ignites with a slight explosion. When the current has been on for three or four hours, the side walls and top of the furnace are completely enveloped by blue flame of carbon monoxide. During the run of a single furnace, five and one-half tons of this gas are given off. At the end of four or five hours the top of the furnace begins to subside gradually, fissures form along the surface, from which pour out the yellow vapors of sodium. At the end of about twenty-four hours, the current is cut off from the furnace and it is allowed to cool for a few hours. Then the side walls are taken down and the unchanged mixture raked off the top of the furnace, until the outer crust of amorphous carborundum is reached. This crust is cut through with large steel bars, and can then be easily removed from the inner crust of amorphous carborundum. The inner crust is next removed with a spade, and the crystalline carborundum exposed.

Carborundum is from two to five times dearer than emery, but meets with ready sale, as it is claimed by its makers to do more work and to do it faster and better.

Since Mr. Acheson discovered carborundum, in 1891, there has been other interesting work done on somewhat similar lines, notably that by Professor Henri Moissan, of France, though, as yet, none of it has resulted in the formation of a new industry, like the manufacture of carborundum. However, in the future, we may expect to see other wonderful results obtained from the electric furnace, in which temperatures can be reached that probably do not fall far short of that of the sun itself.

Among the characteristics of carborundum are: Hardness—Diamond is the only material exceeding it in hardness. It cuts emery and corundum with ease. Brittleness—Not as tough as the diamond, closely resembling corundum in this respect. Weight—Its specific gravity is 3.12. It is a little more than one and one-fifth times the weight of sand. One pound of carborundum is equal in volume to one and one-quarter pounds of emery. Infusibility—Infusible at the highest attainable heat. Decomposition occurs in the electric arc. Insolubility—It is insoluble in any of the ordinary solvents. Water, oils, and acids, have no effect upon it, not even hydrofluoric acid, which readily dissolves sand. Chemical Composition—It is composed of carbon and silicon in equal atomic proportions, and by weight, thirty parts carbon to seventy parts silicon. Its chemical formula is SiC. Color—Pure carborundum is white. In the commercial manufacture the crystals are produced in many colors and shades, partly as the result of impurities, and partly owing to surface oxidation. The prevailing colors are green, black and blue. The color has no effect upon its hardness.

The Carborundum Co. has made arrangements with the Hart-Emery Wheel Co., Ltd., Hamilton, Ont., to supply it with carborundum grains and powders, from which it will manufacture wheels, rub-stones, sharpening-stones, etc., and the Canadian trade will be fully supplied with these goods in the same qualities as are placed upon the United States market.

TORONTO CITY ENGINEER'S REPORT FOR 1897.

The annual report, published by the city engineer's department, of Toronto, has just been issued for 1897. The works of the year have been carried on under the direction of E. H. Keating, C.E., who was city engineer for nearly six years, and was succeeded by C. H. Rust, C.E., in February of the present year. From the report we learn that there were 0.45 miles of asphalt pavements laid in 1897, as against 0.366 miles in 1896, and 1.156 in 1895. In macadam, 0.510 miles were laid in 1897, 1.661 in 1896, and 1.663 in 1895. Gravel roads were laid in 1897 to the amount of 3.138 miles. None were laid in 1896 or 1895. Brick on concrete, 5.803 miles for 1897, as against 1.032 miles for 1896, and 0.744 miles for 1895. The unpaved roads in 1897 covered 78.45 miles. In 1896 they covered 79.74 miles. The total mileage for the year is 258.3, against 257.4 for 1896, 256.4 for 1895, and 253.4 for 1894. The different classes of pavements now laid in the city are as follows:

	Per Cent.
Cedar block	39.24
Stone and scoria	0.31
Asphalt	5.84
Brick	1.37
Wood and concrete	0.21
Macadam	15.68
Gravel	1.25
Cedar blocks with asphalt between tracks	2.10
Cedar blocks with brick between tracks	3.21
Macadam with stone setts between tracks	0.42
Unpaved	30.37

The waterworks consumed 10,355½ tons of coal, pumping 6,723,757,030 gallons of water. The Waterworks Department laid 503 services during the year. At the end of the year there were 2,982 hydrants in use. There were 1,556 meters of all kinds in use in the waterworks branch, of which 936 were Crown, 341 Worthington, and 231 Siemens & Adamson. There were 54 new meters put in during the year. In street sprinkling, the distance traversed by the three trolley tanks was 18,591 miles, the quantity of water discharged in the process of sprinkling amounted to 23,895.700 gallons, representing 8,893 loads. The quantity of water consumed in the ordinary watering service (wagons), was 37,045,375 gallons, or 75,296 loads, making a total for the season of 60,941,075 gallons, sprinkled on the streets.

THE CONSTRUCTION OF GARBAGE DESTRUCTORS.

BY FRANK LESLIE WATSON, ASSOC. M. INST. C.E.[*]

In the design and construction of a successful and economical refuse destructor plant, the following are the principal points which must be borne in mind:

A. It must never be forgotten that the primary object of a refuse destructor is, as its name implies, to destroy refuse, and to destroy that refuse as completely as possible, and without the production of any description of nuisance. By the term to destroy refuse in this connection is implied a practically absolute chemical separation of the combustible portions of the refuse (such as the carbon, phosphates and nitrates, which are found in cinders and in animal and vegetable matter), from the non-combustible portions (which are chiefly mineral), and includes the complete oxidation of the former class, and the fusion and agglomeration so far as is possible into hard clinker of the latter parts. It must be regretfully admitted that in a very large number of destructors, these important objects are only attained to a very limited extent.

In order to insure a perfect result:

(1) A high temperature must be attained; 1,300 deg. Fahr., is admissible, but 1,600 deg. to 1,800 deg. Fahr. is better. It is not sufficient to impart the desired temperature to the furnace gases after they leave the furnaces. Such devices as Mr. Jones' patent fume cremator (intended for this purpose), have done good service in their day in preventing the abominable emanations from the chimneys of old-fashioned low-temperature destructors; but at the best, such a device as a fume cremator is only useful in securing perfect oxidation of the gases and vapors distilled from the refuse, while giving no assistance whatever towards completing the other and equally necessary part of the process—namely, the reduction to innocuous clinker of the solid refuse itself. For this purpose it is essential that a high temperature must be kept up in the furnace itself, as well as in the flue.

(2) Having provided means for securing a high temperature in the furnaces and the flues, such arrangements must be made as will secure that the whole of the refuse and the whole of the products of combustion or distillation must be subjected to this high temperature, in presence of sufficient air, and for a sufficient length of time to insure complete oxidation of all combustible substances.

(3) It is also necessary that the products of combustion passing up the chimney must be as free as possible from solid matter, such as dust, which, although they may be so perfectly burnt as to be free from any taint of putrefaction, yet their mechanical effect upon the leaves of trees and plants, upon the lungs of persons and animals, and upon clothing and furniture, are such as to become an intolerable nuisance, and a nuisance which has been proved in more than one instance to be actionable at law.

B. The destructor must be so designed as to involve the least possible expense in its working. To this end the handling of the refuse should be reduced as much as possible, though it must be borne in mind that the adoption of cumbrous and complicated mechanical feeding arrangements has hitherto been found to give no relief in the matter of labor; in fact, it has even involved additional labor, while at the same time such machinery is frequently very costly, both in construction and in upkeep and working charges. It must always be borne in mind that machinery working in the presence of large quantities of dusty and dirty material deteriorates very rapidly, and any machinery which is required about a destructor, particularly electrical machinery, must be so arranged as to be as nearly as possible boxed in and protected from dust. The author would mention, as an instance, the Shoreditch combined electrical lighting and destructor plant, where, according to the abstract of accounts, published in The Electrical Review, of May 27th, 1898, a large proportion of the total current produced appears to have been used on the works in driving fans, lifting machinery, etc. The author believes that this excessive expenditure of energy is due in a large measure to the extra resistance caused by the impossibility of keeping switches, brushes, etc., in proper order in presence of dust and dirt. In order to ensure economy, the safest points to bear in mind are that the refuse should be brought in the collecting carts, as near as possible to the charging holes of the furnaces, and the tipping arrangements should be such that a minimum of work is involved in properly charging the furnaces. It must also be remembered that considerable judgment is required in working a fire, and that judgment is not usually a faculty possessed by machinery. In order to obviate any difficulty in separating clinker from unburnt matter, and in order to insure as nearly as possible a continuous process in the furnaces, they should be fed at one end of the grate, and clinkered at the other, and the arrangements at the clinkering end should again be such as to involve the least possible labor in removing the clinker and to avoid altogether the necessity for breaking it up in order to get it through small openings.

C. In these days, people are not content with getting rid of the refuse in an inoffensive manner. It has been demonstrated that large quantities of heat are available from the combustion of refuse, and, therefore, it has become necessary that this heat should be utilized, and at present almost the only practicable method of utilizing the heat is in the evaporation of water. When it has been shown that in practical use eight tons of refuse will raise as much steam as one ton of good coal burnt under good conditions, and that it will raise that steam to the highest working pressures ordinarily adopted, there can be no doubt as to the advisability of providing sufficient boiler-room, and arranging a suitable use for the available power. In order to secure the best results, the boilers must be placed near enough to the cells to prevent any important loss of heat by radiation, but they must not be placed near enough to interfere with perfect combustion of the gases, which is generally not completed until after they have left the furnaces and traversed a certain length of flue to insure proper mixing. It must be borne in mind that, even in boiler firing, with coal, any contact of the gases with comparatively cool cross tubes, etc., before they are perfectly oxidized, will check the combustion, and cause smoke, and it is obviously useless to mix any further oxygen with such unburnt gases after they have dropped below their natural temperature of combustion or "flashing point." It may here be mentioned that water-tube boilers are the most readily adapted to the requirements of a destructor station, although very good results have been obtained with other types, particularly Lancashire boilers. The comparative safety of water-tube boilers from explosion, and their general handiness and convenience, render them particularly adapted for working where the labor employed is not of a highly cultivated order, and generally in connection with these plants it is best to remember that, whatever apparatus is provided, it will probably have to be worked by stokers.

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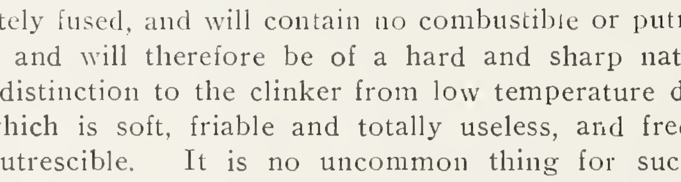
[*] A paper read in the Engineering and Building Construction Section of the Congress of the Royal Institute of Public Health recently held at Dublin.

D. The solid matters resulting from the combustion of the refuse—e.g., clinkers from off the grates and fine ashes from underneath them—must be made use of for two reasons. first, if they are not made use of, they must be carted away and tipped to waste at a further cost. Second, they may be made a valuable source of revenue. It must not be forgotten that we have here another powerful argument in favor of high temperature destructors, the clinker from which will be completely fused, and will contain no combustible or putrescible matter, and will therefore be of a hard and sharp nature, in contra-distinction to the clinker from low temperature destructors, which is soft, friable and totally useless, and frequently even putrescible. It is no uncommon thing for such half-burnt clinker to take fire again, after being tipped into a heap, and thus to occasion serious nuisance. Assuming, however, that the clinker is going to be of a hard and useful character, we shall require machines for breaking it up, grinding it, and mixing it with lime, etc., to form mortar, and these machines must be powerful, massive and durable. Having thus briefly sketched the requirements of a destructor plant, the author will proceed to give some details of the manner in which these objects have been attained in one or two plants in the design and construction of which he has been concerned.

(To be continued).

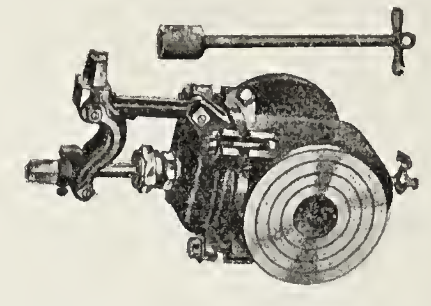
STRAIGHTWAY QUICK OPENING VALVES.

It has been demonstrated by practical boiler users, the makers of this valve state, that the most satisfactory way of arranging the blow-off is to use two cocks—one to open and close and take the wear and tear, and the second cock to make a perfect stop; but even with this arrangement it is necessary to blow down and remove the cocks to make repairs. With the duplex valve all these objections are overcome. The engineer can make the necessary repairs without blowing the boiler pressure down or removing the valve, as he has perfect control over it at all times, and can make repairs or renew the discs during working hours, with the pressure on, thus avoiding breaking joints or using a leaky blow-off, and saving night, Sunday, or holiday work.



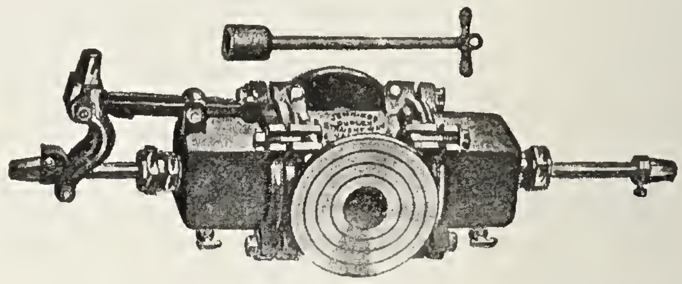
SECTIONAL VIEW.

The object to be attained by this device is to provide an easily operated and durable valve. There is contained within the valve a sliding cage, in which the discs and port are arranged. The valve stem connects with the cage, and a sliding motion is imparted to the cage and valve stem by a forked lever, which is pivoted to the valve body, and has suitable stops to arrest the movement of the cage at the proper place to bring the discs or port in the cage opposite the ports in the valve body. When the ports of the valve are in line with the ports of the cage, the cage covers the seats of the valve, and protects them from wear by scale and grit, when blowing off the boiler. With the cage in this position, the ports form a straight cylindrical passage through the valve, without any obstruction to the current while passing through,



JENNING'S SINGLE BLOW-OFF VALVE.

To close the valve, move the cage so the discs are placed opposite the valve ports, then they are expanded out against the valve seats by rotating the valve stem, which has a taper nut that engages with both discs, to expand or contract them.



JENNING'S DUPLEX BLOW-OFF VALVE.

To open the valve, the valve stem is rotated in the opposite direction to contract the discs, releasing the cage and allowing it to move with ease. The discs should be run all the way back to be sure that they don't drag over the faces of the valve seats and scar them, which will cause a leak. The valve stem is rotated by a special socket lever wrench, which engages with a hub on the ends of the valve stems. To throw the cage from point to point, the socket lever is placed on the hub (which is cast on the end of the forked lever), so as to make an extension and give greater leverage to operate the valve. These valves are placed on the Canadian market by Garth & Co., Craig street, Montreal.

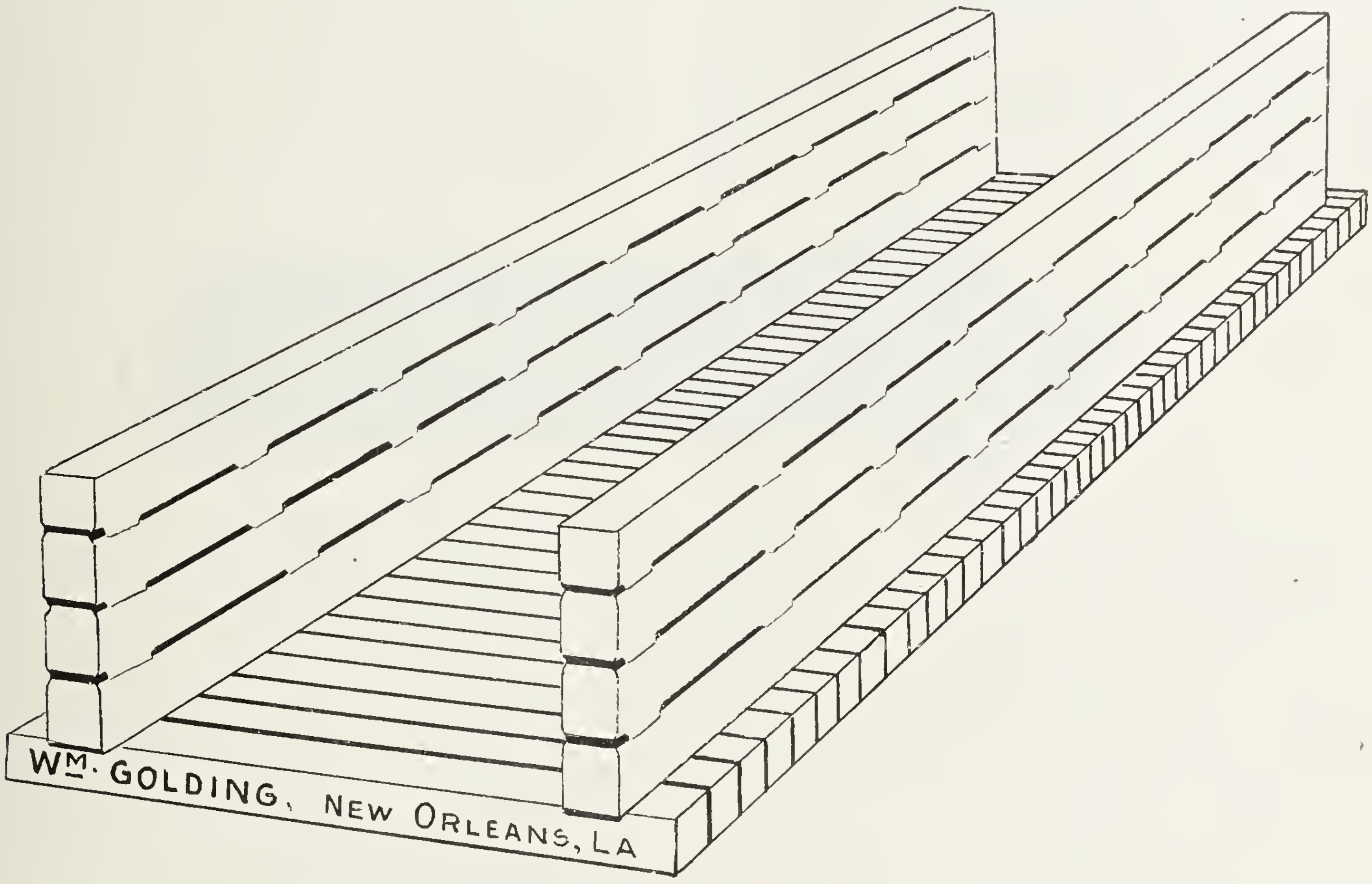
ELECTROLYSIS IN GAS AND WATER PIPES.

The electrolytic effects of the currents leaking from street car rails to the metallic pipes near them formed the subject-matter of two papers recently read before the American Institution of Electrical Engineers. The first was by A. A. Knudson, entitled "An Electrical Survey in the Borough of Manhattan, New York," and the other was on the "Electrolysis of Cast-Iron Water Pipes at Dayton, Ohio," by Harold P. Brown. In both cases great damage was proved to have been done. It appears from the tests made by Mr. Knudson that an open-conduit system, or one in which an insulated metallic return is used, effectually confines the current to the conductors provided for it. H. P. Brown, in conclusion, offers the following comments and practical suggestions on the matters generally to water and gas engineers: Do not imagine because your pipes are not leaking and bursting that they are safe from electrolysis. If the electrical conditions are against them, they are getting weaker day by day. Do not antagonize the railways the moment that the subject of electrolysis comes up. The best course for all concerned is to take mutual action. Do not put down any more lead or wrought-iron service pipes, as these are the first victims of electrolysis, and their replacement means ruin to pavements. Use instead wooden pipe, banded with a close spiral of hoop iron and covered heavily with asphaltum. This will stand the heaviest pressure in use, and is not affected by electrolysis, since the hoop iron is low in conductivity, and is not electrically connected at the joints. Its cost is said to be reasonable, and it has a successful record of many years' service. Use the same kind of pipe for new mains in any district in which a railway power-house is likely to be erected, and heavily paint the lead caulking of cast-iron mains, using asphalt or petroleum wax. In the danger district along the lines of electric roads, and on intersecting streets, put into your water and gas mains two or more consecutive lengths of these wooden pipes so as to break the electrical continuity of the mains, and thus make their resistance greater than that of the rails. Fill in the space around them with broken stone, and connect with drain if possible. Midway between the wooden sections on each main attach insulated pilot wires leading to a central office. Connect similar wires to the rails nearest the pipe wires and make daily electrical tests at times of heavy load. If any section shows positive to the rails cut it at once into smaller sections, and call upon the railway to rebond its line upon that street. This, with the proper electrical management of the railway feeder wires and apparatus, will effectively protect your mains.

A FLOATING DRY DOCK.

Editor CANADIAN ENGINEER.

The annexed sketch illustrates a floating dry dock, designed by me several years ago, the feature of which consists of assembling a number of steel pontoons, aggregating sufficient lifting capacity, and in securing same in such manner as to form a solid structure, and yet permitting the removal of each pontoon for painting and repairs.



For a dock of this type, capable of lifting twelve thousand tons, the length will be five hundred feet, and the inside width eighty feet. There will be forty pontoons, placed side by side, yet two and one-half feet apart, each ten feet wide by twelve feet deep, and one hundred and twenty feet long. There will be eight submerging tanks, constructed precisely the same as the pontoons, which will be placed one upon the other as shown, yet being separated by I bars to facilitate painting. These tanks will be five hundred feet long by ten feet square, each. When the pontoons and submerging tanks are placed in the position shown in the sketch, they will be secured by suitable stirrups, which will pass entirely around each pontoon, and extend to the top submerging tank, thus securing and combining the pontoons and submerging tanks as one structure. The pontoons will be divided into three compartments, each forty feet long. To sink the dock, water will be admitted into the two end compartments, the centre compartments being barely sufficient in the aggregate to balance the entire weight of the dock. When the pontoons are filled, water will gradually flow into the submerging tank through suitable controlling valves, which will be closed when the required depth is reached. For removing the water from the pontoons, there will be placed on the outside ends of same eighty pumps of proper type and size. These pumps will be operated in four sets of twenty each, on one shaft, at each quarter of the dock. The motive power will be electricity, supplied from a power-house conveniently located on land. No water will be admitted to either of the top tanks, in which there will be sufficient reserve to float the entire dock, even should all valves be left open. The objects sought to be gained in this type of dock construction are economy of construction, simplicity in operation, facility of preservation, and absolute safety. Total weight of material is 6,000 tons; net lifting capacity is 12,000 tons; gross lifting capacity is 18,000 tons. It is estimated that a dock of this type and capacity can be constructed and set up, ready for operating, for the sum of $400,000.

WM. GOLDING.

New Orleans, La.

HIGH LEVEL PUMPING STATION, ST. JOHN, N.B.

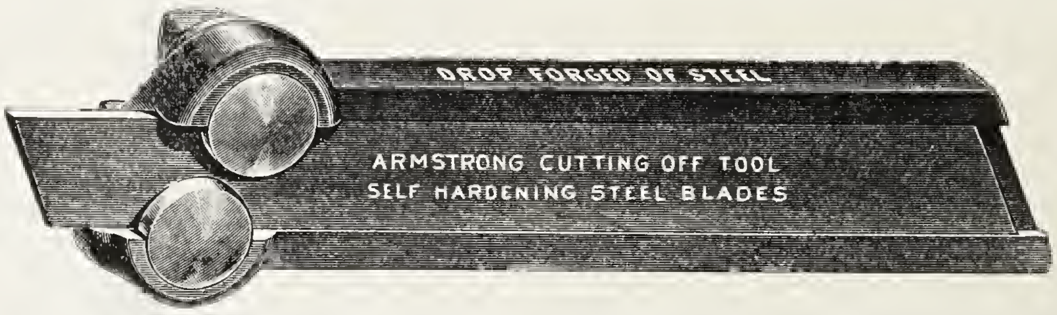
The following description of the new high level pumping-station in St. John, N.B., is taken from the annual report of the waterworks department, made by the engineer in charge, W. Murdoch, C.E.

Under an order passed by the Common Council on July 15th, the work of preparation for the new pumping station at Silver Falls was commenced on August 2nd, by a party of men being sent in to clear the land. It is traversed by Little River for a distance of 475 feet, and comprises the two upper successive porches of Silver Falls, which are 275 feet apart. The lower one of these falls, which is but 140 feet distant from No. 3 leading main, drops into a pool whose surface is sixty feet below the level of the head of the upper fall. The minimum flow observed here at the dryest time was 135 cubic feet per minute. The maximum has not been gauged, as it is often a raging torrent. A stone dam, sixty-five feet in length, and varying up to eleven feet in height, has been built on the upper fall, and a cast-iron flume extended therefrom to the crest of the lower fall. This flume is 24 inches in diameter for a distance of 200 feet, and reduced to 15-inch and 12-inch pipe the remainder of the way. The large pipe was old stock left over from the laying of No. 3 main, 25 years ago, when it was charged to that main.

A frame building is placed at the lower fall, the floor being ten feet above the pool already named. This is for the turbines, and through it the twelve-inch flume will extend to supply the turbines and terminate with a gate valve of the full size, discharging into the river. The two turbines were made by J. C. Wilson & Co., Glenora, Ontario. They are eight-inch horizontal double turbines, with draft tubes, and can be worked either at half gate, when each will develop twelve h.p., or at full gate, when double that power is to be realized. This will enable the obtaining of the full efficiency of a wheel, when only enough water flows to give twelve horse-power, and in an emergency, if such emergency occurs when there is water enough in the river, 48 horse-power can be had. But the main object in having two wheels is to hold one in reserve while the other is in use, so that there be no stoppage in the auxiliary service when once begun. Another precaution against stoppage is that in the rope transmission between the turbines and the pumps, four independent ropes are to be used, each with its own tightener, the whole to be enclosed in a shed reaching up the slope (which rises at an angle of 39 degrees), to pump-house. The pump is being built by the Northey Manufacturing Company, of Toronto. It is specified to be a double-acting power pump with a capacity of 33 imperial gallons per revolution of the crank shaft. A brick building, 16 x 26 feet eight inches, has been built for its reception, at a distance of 15 feet south of the pipe line. As soon as the weather permits, after the arrival of the pump, the main pipe will be cut and a branch led therefrom to the suction of the pump. From the delivery another pipe will return to the main, and between these two branches will be placed a check valve with balanced gate, set in such a way that when the pump is in operation, the valve will close, and the water be driven onward to the city, but should the pump stop, the valve will open and allow the water to gravitate as it does at present, delivering only into the basements of the highest houses.

THE ARMSTRONG CUTTING OFF TOOL.

The Armstrong cutting off tool (patent applied for), is made in seven sizes and is especially adapted for the economical use of self-hardening steel. The latest addition to the Armstrong tools is the cutting off tool, illustrated herewith. This tool will cut off and keep right on cutting off. It stands the racket of constant work, and this is one of the chief points of difference, its makers state, between Armstrong tool holders and imitations of their tools. The holder and bolts are made of steel and hardened. The cutters are made of special grade self-hardening steel, rolled beveled on both sides, giving the proper clearance to ensure a clean cutting tool. The blade requires grinding on the cutting end only. Aikenhead Hardware Co., Toronto, is the Canadian selling agent.



JOHN GALT, C.E.

John Galt, C.E., who was appointed city engineer of Ottawa, Ont., Nov. 14th, and entered upon his new duties Dec. 1st, was born at Kilmaurs, Ayreshire, Scotland, Sept. 23rd, 1852. Although he is comparatively young, his experience as an engineer has been varied and thorough. It has included the construction of railways, canals, waterworks, drainage systems and public improvements of all kinds. Mr. Galt was educated at the Kilmarnock Academy, and, after obtaining a Government science scholarship, he took a full university course, and graduated in engineering at the universities of Glasgow and London. For a time he followed his profession in Glasgow, being engaged in some of the large railway improvement schemes, and was also superintendent and lecturer in the Government science schools in Glasgow for several years. In 1878 he went to the United States, where he was engaged in railway engineering on the Southern lines for three years. Upon coming to Canada in 1881, he wae appointed general manager of the Boiler Inspection and Insurance Company of Canada, retaining this position for four years. Since 1885 he has been engaged as a consulting engineer, and has been very fully employed during that time chiefly upon municipal work.

TRADE IN THE YUKON.

The principal traders in the Yukon, writes a correspondent of The Canadian Engineer, are: The N.A. Trading Co., and the Alaska Commercial Co. These are the two great trading companies, who up to the past season have had almost a monopoly of the local supply trade. They are United States companies, but none the less to be cultivated, as already they are purchasers of Canadian goods. Your letter suggests two very great lacks in our trade circles to-day. One is the fact that our merchants have not yet appreciated the advantage to Canadian trade of the Dawson or local demands. Another is in the reminder of the character of Klondike trade. The average person is half inclined to doubt that Dawson has any demands for textiles, etc. There is a surprise in store for our wholesale merchants in the character of the supplies needed at Dawson, especially this year. People for many months in the year, at least, dress there as here, except that the social laws are less exacting. In the coming time, however, there will be a growing demand for all the luxuries of metropolitan life, and there is a field open in meeting this demand. But the change will come, and we ought to take due advantage of it. With next year will come closer and quicker connection with that country, and following cheaper transportation will be increased demand.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Twelfth Annual Banquet of Toronto No. 1.

The twelfth annual banquet of C.A.S.E., Toronto No. 1, was held at the Walker House, Toronto, on Nov. 23rd, the president, Chas. Moseley, in the chair. The very efficient committee in charge of the banquet arrangements were: A. M. Wickens, Albert Slute, J. G. Bain, J. Bannan, W. C. Tait, J. Marr, chairman; Geo. Thompson, secretary, and Geo. Mooring treasurer. How thoroughly the committee had performed their duties was augured by the large number of members and their friends and guests who assembled a little before 9 o'clock in the corridors of the Walker House, where smiles and jests and pleasant greetings alike to old friends and new acquaintances showed that the stationary engineers need not at least study the arts and graces of hospitality, as they were one and all past masters in that important subject already. The good work of the committee was in evidence throughout the evening, which passed without a single flaw, from the entry of the crowd of nearly two hundred into the spacious dining room, through the well served dinner and the subsequent speech-making and music till the last good-night had been said. The menu was as follows: Spanish olives, celery. Soup—Tomato, aux Croutons. Fish—Boiled Columbia river salmon, Hollandaise sauce, Pommes de terre, a la Parisienne. Entrees—Chicken croquettes, a la Richelieu, escalloped oysters, a la Baltimore. Boiled—Leg of Southdown mutton, caper sauce. Roast—Ribs of beef, with horse radish, young turkey, cranberry sauce. Vegetables—Mashed potatoes, green peas, sugar corn. Game—Haunch of venison, with jelly. Pastry—English plum pudding, brandy sauce; apple pie, lemon meringue pie, raspberry tart, assorted cakes, wine jelly, rock punch. Dessert—Blue-basket raisins, apples, oranges, bananas, filberts, almonds, Malaga grapes, MacLaren's imperial cheese, gorgonzola cheese, tea and coffee.

Before the toast list was reached the assembly had the pleasure of listening to a piano solo by Mr. Fisher, and then the president, Chas. Moseley, in a short speech welcomed the members and their guests to the twelfth annual banquet. After expressing his pleasure at the large attendance Mr. Moseley referred to the growth of the order, and its most satisfactory condition, not only as regards Toronto No. 1, but the other branches as well. The chairman then proposed the toast "The Queen," which was drunk with an enthusiasm which amply demonstrated the loyalty of the engineers of Toronto. W. G. Blackgrove then sang "Soldiers of the Queen," with fine effect, his rich voice stirring the audience to a fresh outburst of patriotic cheers. As an encore Mr. Blackgrove sang "Out on the Deep." The names of Mayor Shaw and Ald. F. Woods were coupled with the toast "Toronto, Our City," The mayor in responding spoke of the present prosperity which is prevailing in Toronto in contrast to the years of depression just passed through. He believed the present expansion would be permanent, and instanced the growth of several of our city's industries, and the entrance into the city of firms formerly doing business outside. He promised that efforts would be made to gain for Toronto some of the general benefit resulting to the country from the enlargement of the St. Lawrence canals. The mayor expressed his sympathy with the efforts of the committee on legislation to secure official recognition of the Examining Board of the Society. Ald. F. Woods confined his speech to an appeal for support in the approaching municipal elections on the score of his being a member of the Typographical Union, and the work he was doing to advance its interests in the city council. The toast of "Canada, Our Country," was proposed amid cheers, and the singing of patriotic songs by Messrs. Fox and Grant, the toast was coupled with the names of Geo. Anderson, manager of the Royal Oil Co., and A. M. Wickens. Mr. Anderson spoke of the growing prosperity of Canada and congratulated the association on the fact that its name of "Canadian" was so truly an indication of the spirit of loyalty in the society. He rejoiced in the fact that Canada is now in closer relations with Great Britain, and is now admitted to the councils of the nation. He pointed out that there was great room for development in the science of mechanics, and that there was therefore room for engineers not only to inform themselves as to what is already discovered, but to make original investigations. A. M. Wickens was proud of his Canadianism, and of his allegiance to "Our Lady of the Sunshine." He referred to the progress of the Technical school, and the good influence of the association in helping it along. The toast of the "Manufacturers," was responded to by C. L. Weeks of the General Engineering Co., J. M. Sinclair, manager Eureka Mineral Wool Co., and Jas. McLaughlin, of the Queen City Oil Co. Mr. Weeks spoke of the keenness of competition in business at the present, and the necessity of taking advantage of all aids to increase production. Mr. Sinclair made a brief speech congratulating the association upon its growth and progress, and upon the good times in the country at large, which permitted in very many industries the employment of day and night shifts. Mr. McLaughlin made what was quite one of the best speeches of the evening, in which he spoke of the fact that manufacturing and trade had been the source from which freedom had come into the state in the old days. He spoke of the unrivalled facilities which Canada offers to the manufacturer in every department of trade in her wonderful natural resources. Formerly Canadian products had to be sold as from the United States, now in many lines the name Canadian adds to the price. Mr. McLaughlin in closing referred to the great progress the oil industry was making in Canada, as witnessed by the building at Sarnia of one of the most complete refining plants on the continent in the past year. "Educational Interests" was responded to by J. Galbraith, principal of the School of Practical Science, Toronto, and A. G. Horwood, secretary of the Toronto Technical school. Mr. Galbraith spoke of the growth of the school over which he presides, and stated that he believed that the science of mechanics as applied to the steam engine was very near its final development, and that little further in this department should be looked for. Mr. Horwood asked the aid of the members of the association in advancing the interests of the Technical school. Bert. Harvey here sang a most laughable and clever medley, and as an encore, "I Want to Join the Army." The toast of the Executive Council was responded to by E. J. Philip, G. C. Mooring, R. C. Pettigrew and A. E. Edkins, who each made a few appropriate remarks. "Sister Societies," was responded to by J. Dixon, Toronto No. 18, and R. Mackie, president of the Hamilton branch of the association, and J. R. Nuttley, Waterloo, who all expressed pleasure in the growth and prosperity of Toronto No. 1. The "Press" was responded to by the representatives of The Electrical News and The Canadian Engineer. A feature of the evening much appreciated by the gathering was the comic singing of J. Fax, whose efforts were received uniformly with tremendous applause. The following were present: A. E. Edkins, A. G. Horwood, R. C. Pettigrew, Ald. F. H. Wood, Mayor Shaw, Chas. Moseley, G. C. Mooring, Chas. Rust, C.E., Geo. Anderson, Prof. Galbraith, Alex. Fraser, John Dixon, A. Lang, Geo. May, Jas. McLaughlin, W. McGee, J. M. Dignum, W. Sherman, A. Doyle, J. Queen, G. W. Gore, W. Sutton, Geo. Bradley, D. McBain, F. Auchlincloss, Chas. Smith, R. Gondy, T. H. Dryden, Sam Thompson, A. Boyce, James Fax, W. Black, W. Keating, A. R. Taylor, E. Terry, F. Barton, Bert Harvey, J. Edward Fisher, J. G. Bain, W. C. Tait, Jos. Bell, W. Bourne, G. Evans, H. Butcher, J. Grout, Fred. Kirk, F. H. Fulshell, R. Galt, A. Richardson, R. Mercy, Joseph Hughes, G. Clatington, Wilson Phillips, M. B. Tullman, John Gourley, Angus McMaster, W. Dawson, D. Hunt, J. H. Pringle, Sam B. Mills, A. J. Woodward, W. Stevens, T. Hope, Geo. Mackie, Robert Mackie, J. Ironsides, Jas. Bannan, Albert Slute, E. J. Philip, C. L. Weeks, Jas. Sitster, J. Ennicht, W. McLean, J. Carson, A. H. Granger, John Emms, Jas. Mooring, W. Pierson, G. Graham, J. Barrow, J. Everett, A. Backer, F. Day, J. Day, J. McLeary, A. Travin, F. Barron, B. Hallen, W. Truckman, E. Ireland, R. Davies, D. McEvoy, A. W. Smith, J. Spencer. J. Prestege, R. Johnston, R. Broughall, E. Dudgeon, S. Graham, J. Fensom, W. Mashinter, J. S. McKay, G. W. Grand, J. Fisher, H. W. Sayton, G. Thompson, W. Mooring, J. Nicholson, J. Granger, A. J. McDonough, E. Ash, W. E. Archer, W. J. Webb, J. S. Anderson, J. Huggett, A. T. Robb, T. Eversfield, E. G. Fowler, G. B. Cowers, J. R. Nuttley, J. C. Long, J. M. Sinclair, W. L. Outhwaite, C. Scott, A. Scott, F. Vantown, T. Hodgson, J. Bannan, M. Burns, J. Fox, W. S. Butler, S. Butler, J. R. Bennett, W. G. Hamner, S. Woodhouse, B. Campbell.

WIND PRESSURE, ACTUAL AND ESTIMATED.

Editor CANADIAN ENGINEER.

In a recent issue of the Scientific American, in an editorial on Sir T. W. Barry's remarks, at the meeting of the British Association at Bristol, anent the want of agreement between the results and conclusions of experiments on a small scale, and the working of nature on a more extensive basis, there is an allusion to the fact, among others, that as far as wind pressures are concerned, and while at the Forth bridge in Scotland, 58 lbs. to the square ft. were allowed for, based on the indications of ordinary anemometers, the result of an experiment on a 300 ft. surface, under like conditions, showed a falling off of very nearly 40 per cent. Again, at the "Tower bridge," London, while conclusions, based on anemometrical readings, indicated a pressure of 6 to 9 lbs. per square ft., experiments conducted on the bascules of the bridge, whose area is 5,000 ft., showed only from 1 to 1½lbs. wind pressure, under absolutely similar conditions. These glaring differences are accounted for on the assumption that a gale of wind presents areas of maximum pressure, which are far in excess of the average pressure. Now, I am in a position to say that this mere surmise of the editor of the S. A., is a matter of fact. Now to the proof: While in a gale at Quebec, the galvanized iron roof sheeting of four of the octagonal kiosks on Dufferin terrace remained untorn, which it had been on other occasions of severe gales; the fifth kiosk, situated in the midst of the other four, not only had its sheeting curled up and twisted and torn off, but the entire roof framing, all of cast iron, and bolted together, was bodily wrenched from its eight supporting columns, the confining bolts of each of which were broken off, and the whole roof, some 2½ tons in weight, carried up a height of say 40 ft., and over a distance of some 300 ft., and deposited in a broken and demoralized condition on the glacis in rear of the terrace. Now, it is evident that in this case there was within the general stream of easterly wind blowing up the St. Lawrence and striking the terrace, an intensified current which struck the demolished structure; a stream within a stream, so to say, as with the "Gulf Stream" in the ocean. I reduced the thing to figures at the time (some ten years ago, or less), and found that while the anemometer at the Quebec observatory on the occasion indicated only 59 lbs., the stress on the roof of the kiosk, thus to tear it away and hurl it to such a distance, must have had a cyclonic force of not less than 100 to 120 lbs. to the square foot. The same thing occurred in the United States a few years ago, when as I then showed in a letter on the subject, published in the Engineering Record, of New York, while the general force of the wind-storm was insufficient to do the mischief, there must have been within the moving river of air, the rush of air in motion, a more intensified stream which struck and overthrew two of the 500 ft. spans of the Jeffersonville bridge, each of which weighed not less than 1,000 tons.

But this does not explain nor in any way account for the difference herein-above alluded to, of the effect of wind currents on areas of varied extent. I think, Mr. Editor, I can account for this. It will be remembered that I was the first, at the time, and for some months before the attention of the world at large had been called to the apparent paradox, to explain (and your journal to publish), the so-called nozzle mystery, which I did by showing that the issuing circumferential jet of water carried with it by friction, the water in the rear of the hall, thus creating a vacuum against which the pressure of the atmosphere reacted to keep the ball in place. Now precisely the same thing happens with the anemometer, and the more so the larger its surface or extent; the wind passing around its periphery sucks out the air in rear of it, creating a vacuum against which the atmosphere pressure on the opposite side reacts.

It will be noticed that while in the case of the Forth bridge, as stated, the larger area of experimentation, 300 ft., gave a wind pressure of only 40 per cent. less than that indicated by the ordinary anemometer; in the case of the Tower bridge, the 5,000 ft. area of the bascule experimented on, reduced the anemometrical pressure of from 6 to 9 lbs., down to from 1 to 1½ lbs.; or not only by 40 per cent., but by from 400 to 600 per cent—this difference being due to the proportional circumferential or linear peripheries of the surfaces experimented on, in comparison with the areas at play, the peripheries varying only as the linear dimensions, while the areas varied on the squares of those dimensions.

For instance, if the anemometer were a foot square, its area would be but one ft., while its periphery were four ft., or the area to the circumferential dimensions, in the proportion of ¼ to 1. With a surface of 10 x 10 ft., the area would be 100 ft., and the periphery 40; area to circumference as 2½ to 1; again, if the surface played on by the wind were 100 x 100 ft., the area would be 10,000 sq. ft., while the periphery were only 400 ft., or the ratio of area to circumference, that of 25 to 1, leaving the wind to act on or around edges of 4', 40', and 400', respectively, while the atmospheric pressure were exercised against areas of 1,100 and 10,000 sq. feet. and thus explanatory of the fact that the greater the area acted on, the greater the reduced percentage of pressure indicated by the larger surface.

C. BAILLAIRGE,
Consulting Engineer, Que.

October 7th, 1898.

Industrial Notes.

James & Reed, Perth, Ont., are enlarging the output of their machine shop.

The new Methodist church, at Madoc, Ont., will be of brick, and cost $12,000.

W. W. Carter is making a large extension to his stave and hoop mill at Fesserton, Ont.

The Pembroke, Ont., Milling Company will build an elevator close to the P.S.R. track, in Pembroke.

The new Intercolonial Railway grain elevator, at Halifax, N.S., is now being built by M. E. Keefe, of Halifax. The contract calls for its completion by January 1st next.

Robert Murray has his new machine shop at Rat Portage, Ont., finished. It is connected with Richard Hall's new marine slip. The entire plant will cost upwards of $10,000.

The Berlin, Ont., Brush Co., will move to Waterloo, Ont., as the former town failed to raise the $1,000 by private subscription that it was proposed to lend the company.

The boiler and machine shops of the British Columbia Iron Works, Vancouver, B.C., are starting up after being idle for many months, owing to the financial embarrassments of the company.

The Canadian Rand Drill Co. requires larger premises for its business, and is asking a free site and a bonus of $20,000 from the city of Sherbrooke, Que., where it has been located for some years.

At a meeting of the council of the town of Farnham, Que., a Montreal furniture manufacturer offered to start an extensive furniture factory here, in consideration of a bonus of twenty thousand dollars.

W. J. Finlay, of Lawrence, Mass., brother of J. D. Finlay, superintendent of the Toronto Paper Co.'s mill, at Cornwall, Ont., has been appointed manager of the mills of the Sturgeon Falls Pulp Co., Ltd.

H. S. Dowd will build a large oatmeal mill at Quyon, Quebec.

E. Gilbault, St. Boniface, Man., has purchased the barb wire works on Lombard street, Winnipeg, and will run the establishment in conjunction with his tin box factory, which will be moved from St. Boniface.

Among other matters of interest in the annual report of the City Engineer of Toronto, is the statement that a new bridge on the Humber river, at the Lake Shore road, will be necessary next spring. Estimated cost, $13,000.

A. A. Scott, Toronto; T. B. White, Kolapore, Ont.; W. Johnston, J. L. White, Heathcote, Ont., and Lizzie K. Scott, Toronto, have applied for incorporation as The Forest Product Company, Ltd. Chief place of business, Toronto; capital, $40,000.

Pierre Mahy, a window-glass blower, of Rensart, Belgium, states that a group of skilled window-glass workers from Belgium, desire to migrate to Canada, and work at their trade here. Besides manufacturing window-glass, all sorts of fluted and cut glass could be produced.

J. H. Chewitt, president of the Rossin Hotel Company, Toronto, has announced that it has been determined to make improvements to the hotel, amounting to $150,000. As soon as the weather will allow, work will be begun on the lower floor entrances. The plans include an addition.

The Canadian Oil and Coal Company, Ltd., has applied for a Dominion charter to locate and develop petroleum wells and coal mines. The chief place of business is Montreal; capital, $1,000,000; incorporators, W. Strachan, J. W. Pyke, B. Shepherd, G. H. Meldrum, Montreal; Hon. A. W. Cole, Albany, N.Y.

A by-law to fix for ten years the rate of taxation of the Ontario Rolling Mills Company, Hamilton, Ont., at $1,200 a year, in consideration of the establishment by it of a horseshoe factory, in the building erected for the manufacture of cut nails, but unused for several years, has been introduced into the Hamilton city Council.

The Taylor Hydraulic Air Compressor Company has, it is stated, completed a sale of its rights for the greater portion of the United States, the price being $200,000. This sale has been effected as a result of negotiations pending for some time, and was made after a thorough inspection of the working of the hydraulic air compressing plant at Magog, Quebec.

The Robb Engineering Co., Amherst, N.S., has received an order from New York for two 300-h.p. engines for an electric railway in Australia. They are tandem, compound, side crank pattern, and the dynamos will be direct connected. This company is working up a considerable export trade, having shipped during the past few months one 300-h.p. engine to England, three 125-h.p. to the Isle of Man, three 125-h.p. to Spain, and one 125-h.p. to Newfoundland.

The St. Thomas, Ont., Brass Co., which has erected a foundry and warerooms, has for proprietors the owners of the Buffalo Brass Co., Ltd. H. H. Hewitt is the president, and they have several branch establishments throughout the United States. The chief matter for comment about the new Canadian firm is that it has settled down to business without the customary period of bonus hunting, and evidently proposes to do business because business is profitable, not because the doing of business may be the cause of the receipt of unearned profits, as in the case of a crossing-sweeper's "tips."

Sissiboo, N.S., Pulp Co., on the river of that name, has four turbines, capacity, 17,000 horse power, and has, states the Weymouth, N.S., Free Press, four grinders, three wet machines, two hydraulic presses, a smaller packing press, and the necessary repair shops, and an electric light and steam heating plant. The mill works day and night throughout the greater part of the year. Scarcity of water in certain seasons sometimes necessitates a suspension. This difficulty, however, has been largely overcome by the construction of reservoirs at convenient stations on the upper part of the river. Some twenty-five tons per day is the average output of the mill, which consumes annually about 3,000 cords of spruce. Employment is furnished to twenty-six men.

A fifty barrel flour mill has been established at Grenfell, Assa., by a local company.

The Bailey Cutlery Co., Brantford, Ont., is now an established industry, having started up November 4th.

Parrish, Lindsay & Co. will erect elevators at Argue and Barber, Man., new towns on the Belmont, Man., extension of the Northern Pacific.

The Ottawa Stock-Yards Abattoir Company, Ltd., has been incorporated, with a capital of $50,000, to carry on an abattoir and stock-yards business.

The Massey-Harris Co., Brantford, Ont., has recently installed a very complete system of fire protection, including a pump with a capacity of 1,500 gallons per minute.

Two new elevators are being built at Arden, Man. One for John Davidson & Co., the other for R. C. Ennis, both of Neepawa. They will be of 25,000 bushels capacity each.

John Reeb & Sons, Port Colborne, Ont., have bought out the Welland, Ont., gas company, and have assumed control. The price paid is said to be $17,000, which includes the five wells and the plant.

Sarnia, Ont., is unable to accept a tender to pipe the streets and supply gas in the town at 25 cents per thousand, as it is found that the present gas company's charter confers an absolute monopoly.

The town of Barrie, Ont., carried a by-law to raise $100,000 to purchase the existing waterworks plant and make extensions to suburban parts of the town. The vote was taken November 7th.

At a public meeting held in Ottawa, Ont., last month, resolutions were passed urging the establishment of technical schools, and the Ottawa Board of Trade has appointed a committee to move in the matter.

The degree of B.Sc. (Bachelor of Science), which it is proposed to substitute for that of B.A.Sc. (Bachelor of Applied Science), now granted at McGill University, will be much more easily understood by the public.

We understand that the Caledonian pottery of Campbell & Purvis, St. Johns, Que., has shut down for a short time. The works of the Canada Stone Chinaware Co. also continue closed, pending the negotiations of Lavoie and Aube with the directors in Paris.

At a meeting of the People's Heat and Light Company, Halifax, N.S., November 16th, it was decided to issue $100,000 worth of second mortgage debentures, bearing interest at 5 per cent., repayable in 15 years. This is to meet the cost of the new plant.

The Laurentide, Que., Pulp Co. has decided to purchase the Grand'mere falls from the government, together with several islands above and below. The matter has gone into arbitration, and the arbitrators are Stewart Howard, C. E. Gauvin, and S. P. B. Casgrain.

Charles C. Dodge, Samuel F. Roop, Warren E. Roop, Oberlin A. Rogers, Ezekiel M. Barteaux, George E. Hutchinson, Edwin S. Dodge, Angus J. Morrison, and Thomas R. Jones are the provisional directors of the Middleton, N.S., Wood-working Co., Ltd., which will carry on a general wood manufacturing business; capital, $10,000.

The working force of E. Leonard & Sons, engine and boiler makers, London, Ont., has, says a special correspondent of the Toronto Globe, in a recent issue, been increased nearly 50 per cent. At the same time much overwork has been found necessary to fill orders on hand. Improved machinery has also been put into this establishment, so as to turn out heavy engines for electrical purposes.

Of Dundas, Ont., a correspondent of the Monetary Times says in a recent issue: "There is decidedly more activity in business generally, especially since the Toronto, Hamilton & Buffalo Railway reached the town one year ago. The old established firm of John Bertram & Sons were never more fully employed, and they employ 225 hands. The senior member of this firm has been in business in Canada since 1861, and the present tool works cover 60,000 square feet of space. There is now being added a tool shop, covering 10,000 feet additional, to erect machinery for heavy work, besides a new branch for paper mill machinery.

The Grand Trunk Railway freight business is increasing so rapidly that the company is now considering the question of erecting another new elevator at Midland, Ont.

The ratepayers of Oshawa, Ont., will shortly vote on a by-law to raise funds to build the waterworks and sewage disposal system, for which John Galt, C.E.; the new city engineer of Ottawa, Ont., has made the necessary plans and estimates.

A public meeting was held in St. John, N.B., a short time ago, and the establishment of a pulp mill at Woodstock, N.B., was discussed. A committee has the matter in hand, and an expert from the United States has been called in. A forty ton mill is contemplated.

The property of the Gardner Tool Co., Ltd., Sherbrooke, Que., in liquidation, was sold November 15th at auction. The stock, valued at some $15,000, was purchased by William Farwell, manager of the Eastern Townships Bank, who also bought the real estate at $600, subject to the claim of the city of Sherbrooke of $18,000.

J. Dobson, C. J. Webb, Philadelphia; R. Peverley, New York; R. T. Hopper, R. D. McGibbon, Q.C.; T. C. Casgrain, Q.C., and W. F. Robinson, Montreal, are to be incorporated as The Beaver Portland Cement Company, Ltd., to manufacture Portland and other cements, and pressed brick, drain pipes, etc.

The Fossil Flour Company, operating at Castlereagh Lake, says the Truro Guardian, has been working all summer, with a goodly number of men, the output being about ten tons per day. The coarser grades of the material are largely used in the manufacture of rubber for fireproof packing. The finer grades are used in various arts and sciences.

An Ontario charter of incorporation has been granted to the North Shore Timber Company, of Port Arthur, Ont. This company is the outgrowth of the firm of Hazlewood and Whalen, pulp wood contractors. The new company is capitalized at $60,000. The members of the company are P. Weidner, E. W. Voight, O. L. E. Weber, A. K. Kiefer, of Detroit, Mich., and R. A. Hazlewood and James Whalen, of Port Arthur. The object of the company is to carry on a general lumbering and pulpwood business.

The Dominion Vinegar Works, Hamilton; the Hamilton Distillery Vinegar Works; A. Haaz & Co., Kingston; S. Allan, Norwich; William Wilson, T. A. Lytle & Co., and the Badgerow, Scott Co., of Toronto, have united and formed a trust. The trust is known as the Wilson-Lytle-Badgerow Company, of Ontario, Limited, with a capital stock of $600,000. William Wilson, Toronto, is president, and William S. Scott, of Badgerow & Scott, is secretary-treasurer. A vinegar factory, for the trust, is being built at the corner of Front street and Spadina avenue, Toronto, at a cost of $150,000. Orr Bros., Toronto, have the contract.

Recent cable despatches in the Montreal Star stated that British capital for iron shipbuilding in Nova Scotia was to be forthcoming, and that the plant would be established in Cape Breton, where cooperation with the Dominion Coal Company would be assured. The iron ore is found in great quantities on the southern cost of Cape Breton, and this, it is said, will be treated at a smelter erected at Louisburg, C.B. The erection of a shipbuilding plant would follow the development of the iron works. So far, the Dominion Coal Co. has not been approached by anyone with any proposition of this kind, though it writes us that it would be glad to cooperate with any company undertaking such a development.

A. W. Campbell, Provincial Instructor of Roadmaking, has returned from Washington, where he has been attending the Municipal Improvements Convention. A great number of subjects was discussed by experts from the United States and Canada, on sewage systems and disposal, waterworks, construction of pavements and roadways, laying out of parks, and tree planting. "The ideal roadway," he said, "was constructed of asphalt blocks, of which many miles had been laid in New York, Boston, Baltimore, and Washington. Sprinkling asphalt at night is the proper method. It prevents the dust and does no injury, but it should be well flushed, in addition, once a week."

There is some prospect of a pulp mill being started at Bathurst, N.B.

The Andover, N.B., waterworks are completed, and the water has been turned on.

Revelstoke, B.C., is to have a sawmill with a cutting capacity of from 25,000 to 35,000 feet per day.

The Watson & McDaniel Co. report a large and increasing demand for the new Jennings Blow-off valves.

The stone work on the piers and abutments of the new inter-provincial bridge, Ottawa, Ont., is very near completion.

The city engineer, Hamilton, has reported in favor of laying the new $160,000 water main by day labor instead of contract.

W. H. Fowler proposes to at once erect a flour mill of 400 barrels daily capacity near the head of Rodney wharf, St. John, N.B.

The Sheffield Cutlery Company, of Montreal, has been incorporated in Quebec; capital, $10,000. The purpose is to make cutlery.

The property of the Ontario Wind Engine and Pump Co., Toronto, has been exempted from taxes for ten years from January 1st, 1898.

The vote on the $50,000 by-law for the purchasing of the Waterloo, Ont., waterworks plant from a private company was voted down by the ratepayers November 21st.

On November 22nd the entire long span between the piers of the Ontario end of the bridge across the Ottawa at Portage du Fort, Que., suddenly gave way, and fell into the river.

It is now an assured fact that at least two of the big saw mills at the Lake of the Woods will be removed to Winnipeg on the completion of the Southeastern Railway to Rainy River.

The Canadian-American Glass Co., recently organized, will establish a large plant at Kingsville, Ont., and will absorb the R. M. Leggett Bottle & Glass Co., Detroit. The Detroit concern has a capacity of 90 tons per day.

Rolland Brothers, importers and manufacturers of cabinet hardware, upholstery goods, etc., Montreal, are about to remove to either Roxton Falls or Farnham, Que., each of which places has offered them a bonus of $20,000 to locate there.

H. E. Moffat, J. A. Bain, E. A. Brown, G. de C. O'Grady, and J. G. Wallace, Woodstock, Ont., have been granted an Ontario charter as the Moffat Feed-Water Heater and Purifier Company of Woodstock, Ltd.; capital, $40,000; chief place of business, Woodstock, Ont.

There are points still to be learned about belting, as all power users will admit. Some of these are stated in another column, in the advertisement of W. A. Fleming, Montreal, Canadian agent for Reddaway's Patent Camel Brand Belting, which as all know has been the subject of one of the most famous patent law suits in Great Britain.

The Economy Manufacturing Company of 613 Washington Life building, 141 Broadway, New York, has just completed the installation of a hydro-carbon gas fuel system at the plant of the B. Greening Wire Company, Ltd., Hamilton, Ont. This plant was equipped under the superintendence of H. Etches, M. Inst. Mech. Eng., 83 Front street west, Toronto.

C. C. Dodge, S. F. Roop, W. E. Roop, Oberlin A. Rogers, E. M. Barteaux, G. E. Hutchinson, E. S. Dodge, A. J. Morrison, J. H. Charlton, W. H. Chipman, A. E. Lawson, W. G. Parsons, F. E. Cox, Middleton, N.S., and Thomas R. Jones, Nictaux, N.S., have applied for a charter as the Middleton Wood Working Co., Ltd.; chief place of business, Middleton, N.S.; capital, $10,000.

The Robb Engineering Co., of Amherst, N.S., received the following orders within a few days: Five boilers for fog horns from the Department of Marine and Fisheries, a 100 h.p. engine and boiler for the new electric station at Campbellton, N.B., a 40 h.p. engine for the electrical plant of the St. John elevator, a 25 h.p engine for the Ogilvie Milling Co., Winnipeg, a 15 h.p. engine for S. Raworth, Port Elgin, N.B., and an 80 h.p. engine for Kilgour Shives, Campbellton, N.B.

The proprietors of Delahay's moulding foundry, Pembroke, Ont., placed a new man over their old foreman last month. The latter resented this and left his work, and the employees struck, to show that their sympathies were with the old foreman.

The new dynamite and powder factories for the Ottawa Powder Co., near Ottawa, are completed. There are seven frame buildings, including magazine, nitro-glycerine house, soda house, pulp house, packing house, root house and engine house.

H. Mooers, E. Mooers, A. B. Campbell, W. J. Doble, Kingston, Ont., and H. F. Mooers, Goderich, Ont., have applied for a Dominion charter as The Frontenac Milling Company, Ltd., to do general flour milling business throughout Canada; capital, $50,000.

According to the Woodstock, N.B., Despatch, there is a possibility of the old Upper Woodstock Iron Works being put into operation, after having been closed down for many years. In 1864 these works produced about 2,750 tons of iron, and employed 75 men.

Belleville, Ont., has passed the by-law relating to the Mitchell-Abbott Iron & Steel Company by a majority of nearly a thousand. The company is composed of Frank A. Mitchell, of Norwich, Conn., and William Abbott, of Montreal. The by-law gives the company free land, exemption from taxation and a bonus of $50,000, to establish rolling mills, etc., in Belleville.

The raising of large boulders in the St. John, N.B., harbor is being accomplished in an interesting manner. A boulder, which weighs many tons, had been slung by the diver with chains. The chains and ropes on the hoisting scows were easily broken in trying to lift the heavy rock. The boulder was again slung, and at low water two scows were brought into use with strong timbers across them. The hoisting gear was secured to the timbers and as the tide raised, the scows lifted the boulder, and at high water the large rock was placed out of the channel.

The Lancaster Machine Works, Lancaster, Ont., have placed on the market something new and good in a pumping engine for creameries and milk skimming stations, by means of which they can operate from one to five pumps. Several attempts have been made to get up an effective pump for this purpose, but it remained for this enterprising firm to surmount the difficulties met with in former makes and give to dairying a complete machine at a low cost. There is already a good demand for them, so the company informs us.

The steel grain storage plant of the Canadian Pacific Railway at Fort William, Ont., is now in operation. The capacity is 3,000,000 bushels, consisting of a series of steel tanks which are airtight, and being also fire-proof, no insurance is carried. The elevator building proper is built of structural steel, with one-quarter inch steel plate floors, supported on "I" beams, the steel frame being covered with heavy corrugated steel. It contains the scales, steel circular garners, steel elevator legs, power shovels, carpullers, warehouse, separators, steel spouting, transmission machinery, and fixture for the weighing and transferring of grain from cars to tanks, or direct to vessels. Two belt galleries run over the top of the tanks. They are built of steel, and contain two belt conveyors, each with trippers for distributing grain to various tanks, or direct to vessels. The shipping capacity is 40,000 bushels per hour. The unloading capacity is 400 cars per day. The boiler and engine-house is built of Lake Superior stone, with steel truss roof, and contains one 400 horse-power condensing engine; three boilers, 66 inches by 16 feet, with all the necessary pumps and fixtures. The power is transmitted from the engine to the steel house by a 400 horse-power rope drive. Tunnels constructed of stone under the tanks contain the belt conveyors for transferring grain from the tanks to the steel building, where the grain is weighed and shipped to vessels by means of the conveyors in the steel galleries over the tanks; dock spouts being attached to the end of the galleries for receiving the grain from the belt conveyors. There are 16 steel tanks, 58 feet in diameter, by 60 feet high, and 32 tanks 20 feet in diameter by 60 feet high. The tanks are ranged side by side, the smaller tanks in a double row, flanked on each side by a row of eight big tanks.

At the recent annual meeting the following officers were elected by the Architects' Association, province of Quebec: President, A. Raza; first vice-president, S. H. Capper; second vice-president, G. E. Tanguay; secretary, Joseph Venne; treasurer, N. E. Doran; auditors, A. Chausse and Heriot; counsellors, Peachy, A. T. Taylor, G. A. Monette and Archibald.

As we go to press we learn that the Canadian Motor Syndicate has completed negotiations for the purchase of a block of land in the central part of Toronto, on one of the main street car lines, and for the immediate erection of a building 40x60 feet. The syndicate is on the look-out for business in various lines, both in electrical and hydro-carbon departments.

W. German, M.L.A., Welland; James Battle, Thorold; W. Thompson, St. Catharines; George Dawson, St, Catharines, and Joseph Battle, Thorold, composed a deputation from Welland County, which recently waited on the Minister of Railways and Canals, seeking for increased water-power privileges on the Welland Canal. The subject is a difficult one for the Government, because while at certain seasons of the year power can be supplied from the canal without inconvenience, yet the complaints which always attend the necessary unwatering of the canal, are a source of considerable trouble to the Government.

The death of John W. Keeley closes the history of one of the most remarkable stories of the century. Mr. Keeley professed to have discovered a new motive power and to have invented a machine to utilize it. The motive power was the ether which permeates all space. He succeeded in convincing great capitalists that his claims were well-founded, and hundreds of thousands of dollars were supplied him for carrying on experiments. But his motor never worked successfully, and he has died without revealing whether he believed himself in some real discovery, or whether he was merely deceiving the public.

City Surveyor St. George, Montreal, and Engineer Janin, who has been given the contract for establishing a sewage farm in St. Denis Ward, Montreal, made recently a trip to a number of cities in the United States, where sewage farms are operated. These were carefully inspected and the result was highly satisfactory both to Mr. Janin and Mr. St. George. Both have stated that the St. Denis Ward establishment would be constructed so as not to be in the slightest degree a nuisance. At Brockton, Mass., the sewage farm skirts the main road and houses are built within a few feet. There is no smell at all from it, the engineers say. Its size is twenty-three acres, all of which are under cultivation. The population of Brockton is 33,000.

Approval has been given by the Ontario Board of Health to the plans of the proposed waterworks for the village of Stirling, Ont. The supply is to be taken from Oak Lake, about 300 feet above the village, and transported in iron pipes. The board feared that there might be danger of pollution to the water supply, but learning that the water was required mainly for fire protection, agreed to the plans subject to the understanding that changes should be made in the event of the proposed system proving dangerous to the public health. The Board has interdicted for the present the construction of a ditch between Welland and Port Colborne, whereby it was proposed to drain Humberstone marsh into the Welland canal. This action was taken on the complaint of Dr. Goodman, the Health Officer of St. Catharines, who pointed out that the proposed drainage scheme would result in the pollution of the Welland canal, from which the water supply of St. Catharines is derived.

FIRES OF THE MONTH.

Nov. 3rd. G.T.R. freight sheds and G.N.T. steamer "Pacific," Collingwood, Ont.; loss, $100,000.——Nov. 8th. Paul Bros'. planing mill, Midland, Ont.; loss, $5,500.——Nov. 11. Wellington, B.C., coal mining engine house, $15,000.——Nov. 12th. Pillow & Hersey bolt works, Montreal, loss covered by insurance.——Nov. 13th. Jos. Shearer's planing mill, Montreal, $10,000.——Nov. 26th. Stevens Manuacturing Co., London, Ont.; damage about $10,000.

—A. E. Payne, E.E., who has been employed by the Royal Electric Company for the past four years as a traveler, will in the future represent the Packard Electric Co., St. Catharines, and R. E. T. Pringle, Montreal.

Mining Matters.

Mica is being profitably worked in the vicinity of Kingston, Ont., this season.

R. Wood, Snow Road, Frontenac county, Ont., claims to have discovered there a vein of ore which contains nickel in paying quantities.

Thomas Byrne, P.L.S. has returned from Michipicoten, Ont., where he has made extensive surveys on behalf of the Ontario Government.

It is said that deposits of iron ore which may be used to produce speigel have been discovered in Cape Breton, and will be extensively worked.

A large flow of natural gas is reported from a well being drilled on Wm. Bellimer's farm at Ryckman's Corners, a few miles from Hamilton, Ont.

The Hall Mines Company, Nelson, B.C., is said to be arranging with the Kootenay Light and Power Co., for power to run the mine and the smelter.

R. H. Ahn is establishing a reduction works at Norman, Ont. The mill is intended to treat the ores of a number of properties in which he is interested.

Five hundred and twenty-nine dollars and twenty-five cents is the value of the first gold brick produced from 33 tons of ore from the Treasure mine, eight miles to the southeast of Rat Portage.

A School of Mines is being established in Rossland, B.C. The following have the matter in hand: E. Durant, J. Martin, W. A. Carlyle, C. O. Lalonde, S. Curtis, R. Adams, J. P. Hennessy and A. Cameron.

Another discovery, said to be of very rich gold quartz, has been made in the new district situated to the southeast of Rat Portage about seventy miles, known as the Sturgeon and Deer Lakes district.

A sample of galena from Great Slave lake was recently sent by J. A. McDougall to Dr. Dawson, director of the geological survey, for assay. The assay shows silver at the rate of 16 ounces to the ton.

A gas well has been discovered on the farm of A. Markham, Tilbury North. An artesian well was being bored for water, when a very large flow of gas was struck. It is proposed to pipe the gas to Chatham, Ont.

The Grand Calumet Mining Company has discovered a rich zinc mine near Rossport, in the Algoma district, and intends opening it up at once. It will be worked all winter. The company has several mines at Calumet Island and has formed quite a settlement there, having erected cottages for the workmen, about sixty in number. The company has shipped 1,500 tons of ore during the past summer, principally to Antwerp, Belgium, the value of which was about $30,000.

The question as to the relative cost of hand or of machine drilling is contributed to by some data obtained by The Rossland, B.C., Miner from J. B. Hastings, the manager of the War Eagle Mining Co. Mr. Hastings keeps probably the most complete account of the expense of working that is to be found in the northwest: In estimating the cost of any work, he includes the cost of management, clerical work, interest, depreciation of the plant, legal fees, and in fact every item of expense which the mine undergoes. In this way his figures are useful for basing estimates upon the various outlays for mining development. It has been contended that hand work is actually cheaper than machine work, as less powder is required, while the expenses of fuel, plants and engines are not experienced. Mr. Hastings' figures show that for drifting by hand the total cost was $35 per foot, while with a machine under similar circumstances the total charges amounted to $17.50 per foot. In the item of underhand stoping, the difference in favor of machines was even greater, for there one stope was worked by hand at an expense of $7.50 per ton, while with a machine the total cost was only $2.50.

Senator Snowball, Chatham; F. P. Thompson, Fredericton, N.B.; J. L. Black, Sackville; Willard Kitchen, Fredericton, N.B., have purchased 57 per cent. of the Modstock Gold Mining Co., whose property is located at Forest Hill, Guysboro, N.S., for $22,800.

R. H. Gibson, Bradford, Pa., who has been exploring lands on Manitoulin Island since April last for petroleum, claims to have been very successful, and struck oil in four wells. He is now engaged in sinking a fifth. The oil was struck at 450 to 600 feet. In two of the wells natural gas and rock salt were struck.

The Le Roi passed into the possession of the British-American Corporation at a meeting in Spokane, Nov. 23rd, when J. C. Mackintosh was elected president, and other directors of the B.A.C. were also elected to office in the Le Roi Co.

Gold mining circles in Nova Scotia are much exercised over the rumored discovery again of the "Rose lead," so-called, in the Montague gold district near Halifax. It is said to have been traced over three properties and is wonderfully rich in gold.

Among the northern mines there are two sections more than any others that at present are looked to as possible rivals of the Klondyke, these being the Atlin Lake field at the northern extremity of British Columbia, and Thistle and Blueberry creeks, just south of the Stewart river. The discoveries at these latter diggings are more recent than the Atlin finds, and definite reports are only now commencing to make their appearance. One of the best of these is furnished by G. H. Bunn, an experienced miner and a member of the Scroggie party—discoverers of the creek of that name—who has come direct from the new scene of mining activity. He says: "Thistle creek is in my opinion one of the best and most promising gold streams of the whole north country. It is on the right side of the Yukon, and enters that river at a point about twenty miles above the Stewart, heading on the opposite side of the divide at a point from the west fork of Scroggie creek, only a few miles from that fork. The mouth of the creek is not visible from the Yukon, as it enters what is called a blind slough, and persons coming down the river do not notice it. The discovery on Thistle was made by a party of eight Scotchmen who had been prospecting in the neighborhood since last July."

The following return recently published in The Montreal Gazette shows the export of minerals from Newfoundland for the year ending June 30, 1898: Copper ore, 38,915 tons to the United Kingdom; copper ore, 17,801 tons to the United States; copper regulus, 9,616 tons to the United Kingdom; iron pyrites, 15,724 tons to the United States; manganese, 1,500 tons to the United States; arsenical pyrites, 125 tons to the United States; iron ore, 44,627 tons to different places. These figures show a steady advance in the mining industry and sufficiently indicate that the product of the mines is taking an important place among the exports of Newfoundland. In the current year (1898-99) there will be a very large increase in the export of iron ore, for which there is an unlimited demand in Great Britain. Before the end of this year there will be 100,000 tons shipped from the iron mine at Belle Isle—or more than double that of last year. The shipping of ore from the new iron mine at Bay de Verde will commence by May next. Shafts are now being sunk, and a railway, five miles in length, to the port of Old Pelican, is under construction, and the output is expected to be very large. A wealthy syndicate, says the correspondent, among whom are some of the great ironmasters of England, have leased this valuable mine, and will work it on a large scale. The vein is sixteen miles in length, and is estimated by experts to contain forty million tons of the finest quality, equal to that of Lake Superior. In the same peninsula, half a dozen more veins of iron ore have been discovered, and now await development. At Grote's Point, too, new discoveries are announced. In fact, the whole district around seems to be highly mineralized. It is evident that Newfoundland will take a high place among the iron-producing countries of the world. Then in copper, of which some ten million dollars' worth have been exported in the last thirty years, there are satisfactory advances. Tilt Cove, the oldest mine, is more active and more productive than ever. Little Bay, which was supposed to be exhausted, has lately taken a new departure, a new copper vein, nine feet in width, having been discovered, and is now worked by a London company. On the west coast, at York Harbor, Bay of Islands, there is also a discovery of copper which promises well.

Railway Matters.

A collision on the Grand Trunk Railway between Montreal and Toronto resulted in the death of 12 persons, Nov. 14th.

J. G. McIntyre, who for over 40 years has been a foreman boiler-maker with the G.T.R., and who for the past ten years has been employed at the Grand Trunk shops at Stratford, Ont., has been dismissed.

Application will be made for a charter for The Arthabaska Railroad Company to build a railway from Dudswell, on the Quebec Central Railway, in Wolfe county, to Maddington Falls, in Ste. Anne du Sault, on the Intercolonial Railway.

By the explosion of a locomotive boiler a terrible accident took place Nov. 10th, on the C.P.R. one mile east of Shuswap, Kamloops, B.C., two men lost their lives, and one was seriously injured. The dead are: E. Reid, brakesman; James Little, engineer John George, the fireman, was badly scalded.

The Rutland & Canadian Railroad Bill has been passed by the Vermont Legislature. The bill passed incorporates the Rutland & Canadian Railroad Company, with a capital stock of $1,000,000, giving it the right to construct a road from Burlington to the Canadian line. The construction of this line will give the Vanderbilts a line from New York to Canada and the great lakes.

The Canadian Locomotive and Engine Works Company, Kingston, Ont., has received the contract to build six locomotives for the Canadian Pacific railway. They are to be compound engines, The largest passenger engine ever built in Canada has just been completed at these works, being the first of five being built for the Intercolonial. The driving wheels are 72 inches in diameter; the boilers are designed to carry a pressure of 180 lbs. to the square inch; the water tank will hold 3,000 gallons and the tender nine tons of coal. The engine weighs 70 tons, and the tender 44 tons, a total of 114 tons. It is fitted with the latest improvements.

A change was made about the 1st November in the management of the G.T.R. locomotive shops in Stratford, over which J. Davis Barnett has presided for so many years, first as assistant superintendent, and latterly, under the terminology of the new management, as master mechanic. Mr. Barnett has resigned, and he handed over his responsibilities to J. McGrath, the foreman of the erecting shop, who now has charge, under the designation of general foreman. The position of master mechanic at Stratford is abolished. The new general foreman is quite a young man, and was born in Toronto. He entered the old Northern railway shop in 1882, and gradually rose to be foreman of the Toronto locomotive repair shops, whence he was sent to Stratford about six months ago to become foreman of the erecting shop there, in succession to A. A. Maver, who was transferred to London.

The Department of Militia, as soon as the necessary arrangements can be effected, will commence the erection of a new building for militia stores at Ottawa. It will be located on the tennis grounds in the rear of the drill hall and will be a four story brick building with adequate accommodation for the storage of the militia supplies for the Dominion. It is expected that the structure will be begun in a short time and completed early in the spring, and this being the case the present quarters at the canal basin will be vacated. When this is done J. R. Booth states that work will be commenced on the new Ottawa Union station. As before stated, the location will be on the site of the present depot and will extend to the bridge. The big building will contain the offices of the railway companies using it, each of which will be on an equal footing and furnish their proportionate cost of its maintenance.

The Central Ontario Railway is to build a spur from Ormsby to Bancroft, Ont.

Trains have begun running into Pembroke over the Pembroke Southern Railway.

Application is being made for a British Columbia charter for a railway from Kamloops Lake to Atlin Lake.

The C.P.R. has arranged to make extensive improvements at Laggan, B.C., including the erection of a stone five stall round house.

The Lake Manitoba Railway & Canal Company has decided to complete another 25 miles of the Swan River extension at once.

Wm. Strachan, president of the Midland, N.S., Railway, and Peter Lyall, one of the directors, recently made an inspection trip over the road.

The necessary money for the charter, surveys and other preliminary expenses for the Thunder Bay & Nepigon Railway has been subscribed in Port Arthur, Ont.

The Ottawa & Parry Sound Railway during the season of navigation just closed, carried twelve million bushels of grain and 100,000 tons of flour and pork from Parry Sound through Ottawa.

Large seizures have been made by the Customs Department of the Dominion involving eighteen locomotives and one thousand box cars, belonging to the Booth system of railways, with headquarters in Ottawa, Ont.

A report is current in Vancouver, B.C., that the Great Northern Railway will bridge the Fraser River at New Westminster and run a line into Vancouver, connecting with the Westminster Southern Railway, part of the Great Northern system. This new line will give the Grand Trunk Railway an entrance into Vancouver via its Chicago connections.

Application will be made at the next session of the Dominion Parliament, for an act to incorporate a company to construct a railway from Dawson, along the Klondyke river to the confluence of Hunker Creek, along Hunker Creek to Indian River, and along its course to its junction with the Yukon River, thence along the Yukon River to Dawson, with power to construct and operate a branch up Bonanza and El Dorado Creeks to Dominion Creek.

General Manager Whyte, of the C.P.R., took over the Crow's Nest Pass railway, on behalf of the C.P.R., on November 15 from Contractor Haney. The town of Fernie, B.C., is now a lively place. The 150 miners who arrived with their families from Halifax are now all at work. Seventy-five coke ovens have been built. In all there are to be about 200 ovens, which will turn out an average of 1¼ to 1½ tons per day each. This coke will be sent to the Nelson and Pilot Bay smelters. The coal at Michael creek, which is now being opened out, not far from Fernie, will produce as much coke per ton as the Fernie coal, says General Manager Whyte, and of much better quality for domestic use.

L. A. Hamilton, C.P.R. land commissioner, who has returned to Winnipeg accompanied by T. W. Tye, chief engineer of the Robson-Penticton branch which is being extended into the Boundary country, stated that while in Montreal they had located the principal townsites along the road. They will be Gladstone, Cascade, Grand Forks and Greenwood, and arrangements have been completed whereby the company has become interested in the development of the towns. Grand Forks is located at the point where the north fork of Kettle river flows into the main stream. Gladstone, which is situated 24 miles from Brooklyn, will be the distributing point for the Burnt basin and Christina lake. Cascade is situated on the international boundary at the foot of Christina lake, and is well supplied with water power for manufacturing and other purposes. Greenwood will be the principal mining point in the Boundary and it is surrounded on every side by developed mines, which are expected to start shipping ore to the company's smelter at Trail as soon as railroad facilities are provided.

Electric Flashes.

It is stated in Montreal that the Royal Electric Co. and the Montreal Gas Co. are to be amalgamated.

The Davidson Mnfg. Co., Montreal, has purchased a 30 h.p. induction motor from the Canadian General Electric Co.

The Canadian General Electric Co. are installing a 100 light electric plant for the Guelph Carpet Co., Guelph, Ont.

C. O. Beauchemin, Montreal, has purchased from the Canadian General Electric Co. a 30 k.w. generator of the multi-polar type.

The Canadian General Electric Co. is installing an electric plant of 100 lights capacity for the Williams Shoe Co., Brampton, Ont.

The North Hatley, Que., Electric Light Company is erecting its poles and putting on the wire, and will soon be in a position to furnish light.

Duncan & McLennan, who have the lighting contract for Campbellton, N.B., state that they will have the lights turned on by December 24th.

The Mispec Pulp Mills, St. John, N.B., are installing an electric lighting plant, and have purchased a 400 light dynamo from the Canadian General Electric Co.

The municipal council of Galt, Ont., and the Galt Gas Company have agreed upon the sum of $67,750 for the gas and electric light plants, which the company is willing to accept.

O. & W. McVean, Dresden, Ont., are installing an electric lighting plant for use throughout their various mills. The Canadian General Electric Co. is furnishing all the apparatus and wiring supplies.

The Canadian General Electric Co. has recently closed a contract with Geo. Matthews Co., Peterboro, for the installation of an electric lighting plant. The dynamo is to have a capacity of 150 lights.

The Toronto Electric Light Co. has placed an order with the Canadian General Electric Co. for a large power generator of the latest multi-polar type. This machine is to be wound to deliver current at 250 volts pressure, and has a capacity of 600 h.p.

The Ottawa Electric Co., Ottawa, Ont., is increasing the arc lighting capacity of its power station, and has placed an order with the Canadian General Electric Co. for two two-circuit automatic regulating "brush" arc dynamos, having a capacity for 125 arc lamps.

Dr. C. J. Edgar, manager of the Eastern Townships Light, Power and Carbide Company, has concluded the purchase of the water power at Nangle's Dam, near Rock Forest, Que. The company intends to transmit power for lighting and power purposes to Sherbrooke, Que.

Cornell Bros., Stanbridge East, Que., are installing an electric lighting plant, and have purchased for their requirements, from the Canadian General Electric Co., a 400 light dynamo of the latest multi-polar type, together with marble panel switchboard and wiring supplies.

The order for a 100 h.p. engine and boiler for the Campbellton, N.B., electric light plant, has been given to the Robb Engineering Co., Amherst, N.S., and for the electrical apparatus to the Royal Electric Co. Duncan & McLennan have the contract, and state that the lights will be lighted Dec. 24th.

The Lieutenant-Governor-in-Council, on the advice of the Attorney-General of Ontario, has referred to the High Court of Justice certain questions to determine whether the non-completion by the Niagara Power Company of the water connections to the extent of 20,000 horse-power, and 10,000 horse-power, actually ready for use, supply, and transmission by 1st Nov., 1898, has not put an end to the agreement between the Park Commissioners and the said power company, giving to the latter the exclusive use of the water-power at Niagara Falls.

The Little Salmon River Telephone Co. has acquired the right to carry its wires into St. John, N.B.

The capital stock of the Northern Electric and Manufacturing Co., Ltd., has been increased from $50,000 to $1,000,000.

A new copper telegraph wire is being strung over the Crow's Nest Pass railway, similar to the one between Montreal and Vancouver. It is also intended to string one into the Boundary Creek district as soon as the line can be built with safety along the Robson-Midway extension.

The municipality of Barrie, Ont., is conferring with the Barrie Electric Light Company regarding the purchase of the latter's plant. The town has placed $35,000 in the council's hands to be spent on a municipal plant, and the question now is whether the existing plant will be purchased or an entirely new plant installed.

Ancaster, Ont., township council has passed a by-law to extend the Hamilton, Chedoke & Ancaster Electric Railway Company's right of way on the highway for another term. The council also passed a by-law extending the time in which the company is to earn the township bonus of $5,000 from December, 1898, to December, 1899.

Notice is given that the Canadian Power Company will apply to Parliament at its next session, for an act to extend the time for the completion of its works, to extend the bonding powers of the company and to more particularly define its powers, and to change its name.

The city council of St. John, N.B., has offered to settle with the street railway, Sir Wm. Van Horne, and James Ross, Montreal, on a basis of five hundred thousand dollars valuation for taxation purposes. The offer is made to cover taxes due from 1895 to 1898, and to avoid litigation. The balance claimed by the city is thus reduced to about $19,500.

The Perth Waterworks Company has completed arrangements for the removal of the engine and boiler, formerly owned by the Tay Electric Light Company. This is a move which the company has adopted to assure constant power to its customers, as in the event of any disarrangement of the water power it would be impossible to supply light. Now steam will be used as an auxiliary power, and a more complete service is anticipated.

In re The Bell Telephone Company and the City of Hamilton, it was decided by the judge that in assessing, for purpose of taxation, the poles, wires, conduits and cables of the telephone company, the cost of construction, or the value as part of the concern, is not the test; they must be valued, in the assessment division in which they happen to be, just as materials which, if sold or taken in payment of a just debt from a solvent debtor, would have to be removed and taken away by the purchaser or creditor.

Thompson vs. The Brantford Electric and Operating Company., Ltd., was an action in which the defendants, by resolution of the Board of Directors, authorized their manager to purchase from the plaintiff, on certain terms of credit, a machine necessary for the carrying on of the defendants' business. The defendants' manager bought the machine, but on different terms, the plaintiff having no knowledge of the board's resolution; and the defendants received and used the machine. It was held, that the purchase was within the scope of the manager's authority, and that the defendants were liable for the price of the machine.

An accident occurred early last month to the dam which was being constructed at St. Gabriel over the Jacques Cartier river for the Canadian Electric Light and Power Company. The heavy rains had greatly swollen the stream, and caused it to overflow its banks, and large quantities of brushwood had also been brought down, and their pressure, combined with the weight of water backed up by the nearly finished work, proved too much for the dam, which gave way suddenly, and was carried down over the rapids. The men and horses working on the dam had barely time to get out of the way of the flood. The loss to the contractors, Ross & Barry, will be at least $2,000. The accident, however, did not cause any suspension in the operations, which were carried on as usual.

The Stouffville Electric Light Co. is making changes in its electric lighting station, among them being a new dynamo with a capacity of 500 lights. It is putting in an S.K.C. two-phase machine from the works of the Royal Electric Company, so that it can supply power as well as light.

The town of Campbelltown, N.B., is installing a civic electric lighting plant. It is putting in Robb-Armstrong high speed engines with Monarch boilers, and one 60 k.w. S.K.C. two-phase dynamo with the full capacity of the machine in transformers. They intend to use this S.K.C. machine for the supplying of arc lamps for the streets as well as incandescent light for interior lighting and for power in the daytime.

The lighting plant of the Stouffville Electric Light Company, which was installed about five years ago, suffered damage a short time ago by the armature bands breaking and wrecking the machine. In replacing this dynamo, there has been installed an S.K.C. inductor type machine, and it will do away with the possibility of having another wrecked armature, or a burnout, or troubles from brushes and commutators.

Acton, Ont., has decided in favor of a municipal electric plant, and municipal ownership of the lighting system is being actively canvassed in Pembroke, Ont., with a probability of being adopted. The Brockville town council has not yet decided in favor of municipal ownership, but if every elector in the town would persistently ask the councillors why it is that gas costs $2.50 per thousand cubic feet in Brockville and only 90 cents in Toronto it would not take them long to come to a decision in the matter.—Brockville, Ont., Times.

The dynamos at the Brockville, Ont., electric light station were stopped at night during the storm of November 17th and 18th on account of the inability to procure sufficient water for the boilers in the engine room. This was caused by the severe eastern gale lowering the water below the intake pipe which is lowered eight feet below the surface of the water. The lights were not started again until the wind lowered and the water resumed its level sufficiently to cover the intake pipe. The lights were out for several hours.—Brockville, Ont., Times.

For some time past Lindsay, Ont., has been trying to secure a cheap electric power. Culverwell & White-Fraser of Toronto undertook to form a company and transmit the power from Fenelon Falls to Lindsay, but were unable to make the financial arrangements necessary to the undertaking. The matter has been taken up by some of the citizens with A. E. Ames of Toronto. An electrical expert is to be employed to look into the matter, and if it is endorsed by him and a certain amount of stock taken by the citizens, Mr. Ames will, it is said, undertake to secure the necessary capital to carry the scheme through.

The Welland Vale Manufacturing Company of St. Catharines has increased its factory buildings, and is making a change in the lighting plant. It has, heretofore, operated a direct current two-wire system, but has decided to keep pace with the times, and is installing a 600 light alternating current two-phase S.K.C. plant, which will operate on the three-wire system, giving them a much cheaper distribution, as well as the benefit of having an inductor type dynamo, which they are satisfied possesses a great many advantages over those of the old type. They are following in the lines of the Penman Mnfg Co., of Paris, and the Cockshutt Plow Co., of Brantford, which have replaced their direct current incandescent plant by inductor type machinery.

The proposal of the directors to increase the capital stock of the Royal Electric Company from $1,500,000 to $1,750,000 by the issuance of 2,500 shares of the nominal value of $100 each, to be offered to the shareholders; and also to effect loans by the issuance of mortgage or hypothecary bonds or debentures to an amount not exceeding in the aggregate, including all bonds at present outstanding, 75 per cent. of the paid-up capital stock, and to bear a rate of interest not exceeding 4 per cent. per annum. was not favorably entertained by the shareholders, of whom the majority seemed to favor the raising of all needed funds by allotting additional stock instead of adding to the bonded debt of the company. It was decided to increase the holding of the Royal Electric Co. in the Chambly Manufacturing Company from $200,000 to $300,000.

The report of Percy Domville, the expert electrician engaged to prepare an estimate of the cost of a civic lighting plant for Hamilton, Ont., has been submitted to the city council. The substance of the report is favorable to the position of those who favor the installation of a civic electric light plant. At present Hamilton pays 25 cents a night, or $91.25 a year, for each arc light. Mr. Domville estimates that with a civic plant it would cost the city only 14.93 cents a night, or $54.55 a year for each arc light. This estimate includes interest on investment and a liberal allowance for depreciation of plant, and Mr. Domville says his estimate is too high rather than too low. Accordingly it would pay Hamilton to do its own street lighting. The difference between the price paid and the estimated cost of production is about $15,000 a year.

James Ross, vice-president of the Montreal Street Railway Company, who has recently returned from an extended visit to Great Britain, made some interesting remarks upon street railways in Britain and other matters, in the course of an interview with The Montreal Gazette. Mr. Ross observed that while he did not wish to cast any reflections upon the municipal bodies of Great Britain as regards the slow manner in which they moved, yet it was a fact that most of the cities were extremely conservative in the matter of a change from horse or steam to electrical power. The overhead system appeared to be generally accepted, and Liverpool and Glasgow, which had purchased their respective street railway systems, had each from two to three miles in operation. Bristol and Dublin were also to have the trolley. In Birmingham the people were undecided what course to pursue, and they will, Mr. Ross added, probably await results in the other cities. Mr. Ross also stated that all lines of business in Great Britain seemed to be prosperous.

The McGill Applied Science Technical Society listened recently to a paper, written by R. M. Wilson, science, '99, which was a report upon the testing of the electrical generating plant, put in by the Royal Electric Company at Chambly. The river at Chambly has been harnessed and by means of the machinery described by Mr. Wilson will soon send over heavy copper wires, energy equivalent to 11,000 horse-power in the form of high pressure electricity. The transforming of the power of the water into electric current is effected by four generators, and in the testing of these generators Mr. Wilson was engaged. The electrical equipment at present consists of four two-phase generators of 2,000 k.w. capacity each, two 140 k.w. exciters and necessary high and low tension switchboards for same, with wiring. The main part of the paper was taken up with a relation of the methods of testing the machines. So rapid are the strides made in electrical advancement that scarcely two plants are built in the same way, and thus in the setting up of each plant there is a great deal of interest attached to the testing of the machines, the tests showing the results of the new ideas involved.

Marine News.

The steamer "Edna Brydges" ran on a reef and sank on her last trip from Rat Portage to Fort Francis, Ont.

The Montreal Harbor Commissioners have bought a tug from Carrier, Laine & Co., Levis, Que., for $20,482.

The steamer "NorthernBelle" was burned Nov. 7th, about two miles up Byng Inlet, Ont. The cause of fire is unknown.

Kivas Tully, harbor engineer, and C. H. Rust, city engineer, Toronto, have prepared plans for extensive harbor improvements.

J. & A. Allan are building two new steamers, each of which is to be fitted to carry a large quantity of produce in cold chambers, for the cooling of which J. & E. Hall, Dartford, England, are supplying the machinery.

The new steamer "Toronto," of the Richelieu and Ontario Navigation Company's fleet, has been given its trial trip last month. The boat was out three hours, and was in charge of Captain William Boyd, and everything ran smoothly both in the machinery and general management. The chief engineer is W. A. Black. Among those present were J. Kerr Osborne of the Richelieu Company ; George H. Bertram, M.P., president of the Bertram Company ; John Bertram, vice-president ; A. Angstrom, manager.

We are informed that J. & E. Hall, Ltd., have no less than seventy refrigerating machines to be fitted on board ship at the present time, which comprise machines for the British Admiralty and foreign Governments, the White Star Line, Hamburg-American Steam Packet Company, and many others of the most important steamship companies.

The new Government steamer now being built at Dundee, Scotland, for service between Prince Edward Island and the mainland, to replace the "Stanley," will cost $185,000. Its tonnage is about 1,200 with 2,900 horse-power. It will be provided with a strong protected stern for breaking ice, and its rudder will also be protected by a stee ice cutter.

Lieut.-Col. Anderson, chief engineer of the Dominion Department of Marine and Fisheries, has reported the result of his examination of the ship channel between Montreal and Quebec, in which a number of steamers have recently grounded. He says the opinion is freely expressed that a good deal of the trouble in the navigation of the river arose from the ignorance of some of the pilots.

The importation of beef to England from America is still on the increase. Two fine steamers building for the Atlantic Transport Company by Messrs. Harland & Wolff are to be equipped with a complete installation of refrigeration on J. and E. Hall's Carbonic Anhydride System, the machine being situated in the main engine room in both cases, which arrangement reduces the staff as compared with a separate engine room necessitated by some systems.

J. B. Coyle, manager of the International Steamship Co., died at his residence in Portland, Maine, recently, after a protracted illness. Mr. Coyle had been associated with the steamship business for many years, and was a long time chief engineer of the International Line, but became president and manager of the company about ten years ago. Some time ago he resigned the presidency but retained the position of manager. He had been manager of the Portland Steam Packet Company and the Maine Steamship Company.

By the contract between the Dominion Government and the Allan Line and Dominion Steamship Lines for the winter service between St. John and Liverpool, the first boat left Liverpool on the 12th ult. The first sailed from St. John on the 30th. For the first five weeks the sailings will be weekly from Liverpool on each Saturday. After that they will be on Thursdays. From this side, the sailing will on Wednesdays, unless other arrangements are made later on. The boats to be employed are the "Parisian," "Numidian," "Californian,' "Labrador," "Vancouver" and "Scotsman."

Property owners along the river front at Amherstburg, Ont., are clashing with the United States Government over the lime kiln crossing dredging operations. Dredges have been for some time at work widening the channel by blasting and dredging from the Canadian bank. Heretofore the work has been going on above Amherstburg. Recently, however, a dredge under Captain Rooney, began work directly opposite the town. The property owners along the bank of the river immediately served notice on the captain to cease the work. They claimed that under the Crown patents the title of property extends to the bank of the channel. Therefore, in blasting away the bank they argue that the United States is stealing their property. Captain Rooney paid no attention to the protest.

It has been announced that one of the principal steamship lines running to the St. Lawrence is prepared to establish its terminus at Quebec on the basis of an exemption from all harbor dues for a term of five years. This information has been conveyed by a letter from the Hon. P. Garneau, president of the Great Northern Railway, to the chairman of the Quebec Harbor Commission, which states that the company in question is ready to negotiate with Quebec whenever it is prepared to close a contract on those terms, and to run a regular line of steamers between Quebec and Liverpool, loading the freight brought over the Great Northern and Parry Sound Railways to Quebec.

Work is progressing very satisfactorily on W. Davis & Sons' contract on the St. Lawrence Canal at Cardinal. It is the largest cut for the area of any canal on the continent, there being almost two million yards of excavation. The length from the point where it leaves the old canal below the town to where it re-enters above is one and one-third miles. There are four steam shovels, nine locomotives, a large number of horses and from six to seven hundred men employed. The contractors operate about fifteen miles of tracks and are dumping the earth two and one-half miles below the cut. The locomotives are averaging about twenty-eight trips every twenty-four hours and the Starch Works Company supply electric light from end to end, so that the work of excavation goes on all night.

Personal.

Henry Weston, Montreal, has been appointed managing foreman of the C.P.R. workshops at Perth, Ont.

G. Whittaker, Toronto, has been appointed second assistant superintendent of the street railway, London, Ont.

F. A. Wunder, New York manager of the Fort Wayne Electric Corporation, of Fort Wayne, Ind., was in Toronto recently.

Newton J. Kerr, an assistant in the city engineer's office, Toronto, has accepted the position of assistant city engineer, Ottawa.

Jno. Milne, head of the stove manufacturing firm of Burrow, Stewart & Milne, Hamilton, Ont., fell and broke his leg last month while walking home from his office.

John Kerr, the motorman on the Toronto Railway who was injured in a collision last summer, is suing the Street Railway Company for $7,500.

Sir John Fowler, who was engineer-in-chief of the Forth bridge, for which services he was a created a baronet in 1890, is dead. He was born in 1817.

C. G. Rothwell, assistant last session to Professor De Kalb, Kingston, Ont., School of Mining, has been appointed assistant manager of El Concheno mine, Chihuahua, Mexico.

R. S. Logan, Montreal, assistant to Chas. M. Hays, general manager of the Grand Trunk Railway System, was married at St. Louis, Mo., last month, to Miss Annie Rankin.

F. W. Dawson, engineer for the Indian Government at Bombay, has been in Canada recently looking over the Canadian system of canals for the information of his Government.

The employees of the New Vancouver Coal Co., Nanaimo, B.C., recently gave a dinner to Thos. Morgan, the new coal mines inspector for British Columbia. Wm. McGregor, superintendent of the mine, was in the chair.

R. G. McConnell, of the Geological Survey, has returned to Ottawa from the Klondyke and left for the East. He traveled a good portion of the Yukon and will make an extended report to the Department of the Interior.

Wm. Findlater, of the firm of Bannerman & Findlater, Elgin st., Ottawa, Ont., died a short time ago, after a brief illness. Deceased was 37 years of age, and was a cousin to the hero of Dargai Ridge. He leaves three orphan children.

Hartley Gisborne, M. Can. Soc. C.E., electrical engineer, formerly of Toronto, now of Winnipeg, has been appointed by the council of the Institution of Electrical Engineers, London, England, their local hon. secretary and treasurer for Canada.

The wedding of Collingwood Schreiber, Deputy Minister of Railways and Canals, to Miss Gwynne, daughter of Judge Gwynne, of the Supreme Court, took place November 14th at Grace Church, Ottawa. The wedding was private, only near relatives being invited.

We regret to announce the death of Matthew Cooper, foreman of the Canadian General Electric Company, which occurred at Peterboro recently. Mr. Cooper was for some years foreman of the Edison Electrical Works, Hamilton. He leaves a widow and six children.

Dr. S. A. Mitchell, son of John C. Mitchell, contractor, Kingston, Ont., has been appointed research assistant at the Yerkes Observatory in connection with Chicago University. He is a graduate of Queen's University, Kingston, with the degree of M.A. He also has the degree of Ph.D. from Johns Hopkins University, Baltimore.

Robert Hobson, secretary of the Hamilton Blast Furnace Company, met with a painful accident a short time ago. He had ridden up on a coke train from the smelting works to the Radial line, intending to take a car to the city. As he started to jump from the coke car one foot caught in the ledge and he fell to the ground, breaking his leg just below the knee. He was brought to the city on a Radial car and removed to his home.

W. S. Buckland, Montreal, has received the pleasing information that his son, who had served some time in the C.P.R. shops in Montreal, had, while in England, passed his examination for the Royal Navy, and received the appointment of engine-room artificer, which makes him a first-class petty officer. He had to compete against Old Country boys, and it speaks well for Canadian training when it is known that he took seventy-five per cent. of the marks.

F. S. Rathbun, one of the active partners and treasurer of the Rathbun Company, Deseronto, died suddenly while dressing on the morning of Nov. 26th. He appeared in the best of health and spirits on going to bed the night before at his usual time, and got up at his usual time, and went into his dressing-room, where, without any warning, he suddenly expired. He had lived all his life at Deseronto, and had taken a deep interest in, and done much to advance the commercial prosperity of the town. The news will be received with deep regret among his wide circle of friends, by whom he was very much liked and appreciated. Besides his active participation in the work of the Rathbun Company, he had interested himself in many of the commercial enterprises, railway and steamboat connections that have contributed to make Deseronto what it is.

The Kilmarnock Standard (Scotland), on the occasion of the laying of the foundation of stone of The Dick Institute, Public Library and Museum, presented to his native town by James Dick, at a cost of £11,000, refers in an interesting column of "personal notes" to the great success which attended all business enterprises in which the Dick brothers engaged; commencing with the adoption of gutta percha in the manufacture of boots, which for thirty years was their staple manufacture. Then, in 1870 they began to consider the capabilities of balata, a species of India rubber for strengthening cotton for belts, which became immediately successful for all kinds of machinery. Twelve years ago, on the occasion of his marriage, James Dick presented to the people of Glasgow the Cathkin Park, a gift that cost about £50,000. While on his bridal tour, which included a visit to Melbourne, Australia, the discovery of the Broken Hill Silver mine was brought to his notice, and he bought a seventh share of the whole mine, and sailed away. While he was on the sea his seventh share became a fortune. On his return, his brother Robert having died while he was away, he had to assume the proprietorship and management of the Greenhead works. Unexpected success attended him. The balata belts were found to be the best for machinery, especially in the deep shafts of gold mines in Johannesburg and other places. On one of his many journeys he secured a large interest in the Mount Morgan mine, which in itself would make him one of the wealthiest men in Scotland.

LITERARY NOTES.

We have received the annual reports of the city engineers of St. Louis, Mo.; St. John, N.B., and Toronto, Ont., whose contents are referred to in other parts of this issue.

The well-known "Hawkins'" books for engineers, firemen, electricians, superintendents and all steam users, are attracting a great deal of favorable notice from the reading public.

The Aikenhead Hardware Co., 6 Adelaide street east, Toronto, has issued a pamphlet describing the Pasteur Filter, under the title, Drinkable Water and its Hygienic Value in Health and Epidemic Diseases.

We are in receipt of a catalogue of the Standard Tool Co., Cleveland, U.S., which manufactures electrically welded bicycle parts, etc., which gives some interesting information about this line of the company's output.

The Scientific American Hand Book on Patents, Caveats, Designs and Trade Marks, published by Munn & Co., New York, contains valuable and useful information for the inventor who intends to protect in the United States the product of his genius.

The National Association of Master Plumbers, Gas, Steam and Hot Water Fitters, of Canada, has begun the publication of a monthly magazine, "The Official Bulletin," whose first number appeared last month. We take pleasure in welcoming the new journal to our table.

"Steam" is a handsome cloth bound volume of 130 pages, of which every one contains something an engineer wants to know. It may be had free by sending your address to the Babcock & Wilcox Co., 202 St. James street, Montreal. The illustrations are very numerous and show many of the finest and most famous buildings on the continent.

The proceedings of The Association of the Ontario Land Surveyors at its sixth annual meeting since incorporation have just been issued. The meeting was held Feb. 22nd and March 8th, 9th and 10th, 1898 and was well attended by the members as was reported in The Canadian Engineer for April. The report makes a volume of over 258 pages. The seventh meeting of The Association of Ontario Land Surveyors will be held in Toronto, beginning February 28th, 1899.

The Tidal Survey Branch of the Department of Marine and Fisheries of the Dominion of Canada has issued the Tidal Tables for Halifax, Quebec and St. John, N.B., for the year 1899, with tidal differences for the Atlantic coast of Nova Scotia, and for the St. Lawrence River, from Three Rivers to Gaspe. The tables are reprinted from Greenwood's Nautical Almanac and Tide Tables for 1899.

The eleventh edition of Lovell's Business Directory of Montreal has been prepared with the care and completeness which characterizes the works of reference issued by this well known firm. The present edition comprises a classified business directory with a general index to the classification, a guide to the streets of the city, and a large body of miscellaneous information, including the customs tariff.

The Year Book of Canada for 1897 has been issued from the Department of Agriculture, Ottawa, and contains the usual mass of statistics relating to every department of trade, commerce, finance, etc., of the Dominion. The compiler, Geo. Johnson, F.R.S.S., now ranks among the highest statistical authorities of the British Empire, and the present volume sustains his well-earned reputation.

The "Practical Engineer" Pocket Book, 1899, is a neat, strongly bound volume of convenient size; leather with gilt edges. There are over 400 pages of valuable matter clearly expressed and brought into small compass. There is a combined memorandum book and calendar included in the volume which is a most convenient feature. The "Practical Engineer" Pocket Book, the Technical Publishing Co., Ltd., Manchester, England.

We have received "Sewerage and Sewage Disposal," by Henry Robinson, M. Inst. C.E., Fellow of Kings' College, London; Professor of Civil Engineering, King's College, London, etc., etc., which is a very substantial volume of about 200 pages, published by E. & F. N. Spon, 125 Strand, London. The tabulated statistics are very valuable and comprehensive. The American trap system is unsparingly condemned on page 16. Though the American system is not explicitly mentioned; the advocacy of the free ventilation system described in The Canadian Engineer is very strong.

It was in the year 1847 that the first issue of the Canadian Almanac was published, and every year since it has made its appearance. Among the contents of the book which are especially valuable are: The Customs Tariff, Postoffice Guide, and Directories of various persons and officials, all of which are brought up to date, while the articles on the British Army and Navy and Forms of Government throughout the world are interesting and reliable. A feature that appeals particularly to all who are interested in the current history of the world is the Historical Diary, which is carefully prepared each year, and gives an excellent resume of the year's history. The publishers are to be congratulated upon the appearance of the 52nd issue of the Canadian Almanac. Price, 25 cents. The Copp, Clark Co., Limited, Toronto.

"Steam Navigation and its Relation to the Commerce of Canada and the United States," is the title of a very interesting volume by James Croil, of Montreal, published by William Briggs, Toronto, and produced with the usual typographical excellence of books issued by the Methodist Book Room. Mr. Croil is already known by his "Dundas; a Sketch of Canadian History," published a good many years ago, and now out of print. The present volume is the result of much painstaking labor, and traces the history of steam navigation from the beginning down to the past year or two. Most of our readers already know that the first vessel to cross the Atlantic entirely by steam was one of Canadian design and workmanship, namely, the Royal William. This vessel, by the way, was not only the first commercial steamship, but became the first steam man-of-war, as after being for some years in the Anglo-American trade, she was sold to the Spanish Government, and then to the Portuguese Government, who had her converted into a gun boat, propelled by steam. The author gives a very full account of the Royal William, whose achievements were considered worthy of the following tablet in the Canadian House of Commons: "In honor of the men by whose enterprise, courage and skill, the Royal William, the first vessel to cross the Atlantic by steam power, was wholly constructed in Canada, and navigated to England in 1833." Mr. Croil refers to the fact that the Molsons, who were prominent in the first development of steam navigation on the St. Lawrence, failed to get a monopoly of steam traffic in Lower Canada as Fulton had done in New York. It may be interesting here to recall the fact, not generally known, that Louis Papineau, the agitator, was among those who voted for this monopoly. The record of navigation on the Upper Lakes is rather deficient, but when allowance is made for this, the work is a most valuable history of steam navigation in Canada, while a good deal of general historical matter on the development of steam navigation throughout the world is brought under the reader's view. The volume contains 381 pages and about 100 illustrations.

The Rev. Chas. M. Sheldon's books, now so universally read, make it plain that that writer's hopes of the regeneration of the world lie in getting individuals more and more to do their daily tasks on Christian principles no matter what the sacrifice involved. In the best known of his books, "In His Steps," he clearly looks to the newspaper, carried on upon Christian principles, as largely the hope of the "coming kingdom." In looking about him for a newspaper upon his model, he seems to have hit on The Montreal Witness, to which he has addressed a letter, part of which we quote: "I have read The Witness with much interest. I cannot say that I know of any other daily paper in the United States that is conducted on such high Christian principles. I wish I did, for if ever we needed such a paper in our country we need it now. Let me express to you my appreciation of the Christian heroism and consideration which make a paper like The Witness a possibility. I have always believed it possible for a Christian daily to succeed. You have proved that it can. So much of the ideal newspaper in 'In His Steps,' is therefore real. I pray that you may continue to be blessed in your work. I do not know a more glorious opportunity for building up the kingdom on earth than by means of Christian journalism. I take the greatest pleasure in sending the copies of The Witness to newspaper friends of mine for their inspection. Charles M. Sheldon."

—Of nails, the imports into Japan from the United States increased from 3,260,858 katties in the first half of last year, to 7,494,197 katties in the first half of the present year—the katty being about 1.3 pounds; the total importations of nails had fallen meanwhile from 10,394,717 katties in the first half of last year to 8,754,035 in the first half of the present year.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports of interest to the metal trades from Great Britain during October and the ten months ending October, 1897, 1898 :—

	Month of October.		Ten months ending October.	
	1897.	1898.	1897.	1898.
Hardware	£7,921	£2,039	£58,593	£22,042
Cutlery	..	5,163	..	45,414
Pig iron	1,187	1,474	6,435	9,879
Bar, etc.	306	1,856	7,878	10,156
Railroad	6,885	..	45,778	25,154
Hoops, sheets, etc.	15,307	7,571	71,261	52,382
Galvanized sheets	13,439	11,034	49,986	55,286
Tin plates	30,122	19,843	162 971	123,882
Cast, wrought, etc., iron	2,932	4,196	28,889	28,653
Old (for re-manufacture)	1,292	..	6,483	3,574
Steel	6,440	3,696	47,501	43,430
Lead	4,888	7,360	23,950	32,025
Tin, unwrought	1,169	1,727	14,983	15,407
Alkali	8,767	10,440	34,849	42,475
Cement	2,880	5,835	18,491	23,762

—The Knowles, Ham & Nott Company are about to make extensive additions to their spring bed factory, Brantford, Ont., and the Brantford Starch Company are now putting another storey to their building in order to meet the increasing demands of their business.

—The Kirk-Latty Manufacturing Company, of Cleveland, manufacturers of tacks, trunk cloth and small nails, are talking of locating in London, Ont. The Mann Manufacturing Company, of Brockville, Ont., farm implement makers, have also communicated with the Council regarding inducements to locate a branch of their business there.

PERSONAL—Will Mr. H. Weir, who formerly resided at 42 St Alexander St., Montreal, kindly communicate with us. Any friend of Mr. Weir knowing his present address will oblige by calling his attention to this advertisement. BIGGAR, SAMUEL & CO., Publishers Canadian Engineer, Fraser Building, Montreal.

TENDERS FOR BRIDGE CONSTRUCTION

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Sealed proposals for the construction of a combined Railway and Highway Bridge across the River St. Lawrence, near Quebec, will be received by the undersigned until noon, Monday, January 2nd, 1899.

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ULRIC BARTHE Secretary

Quebec, September 24th, 1898.

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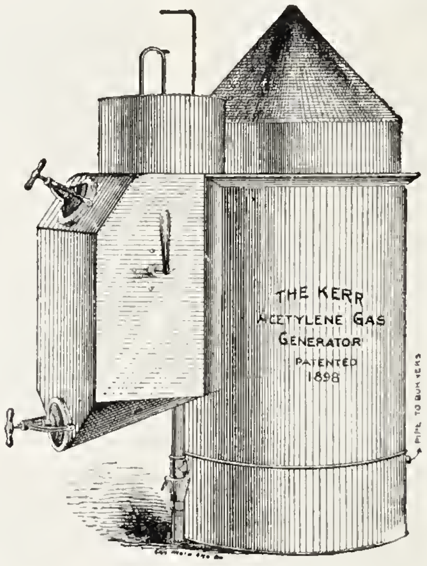

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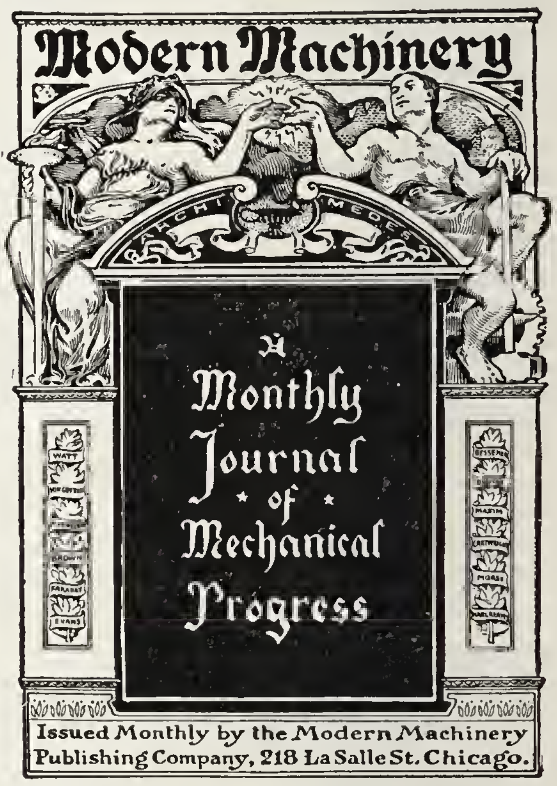

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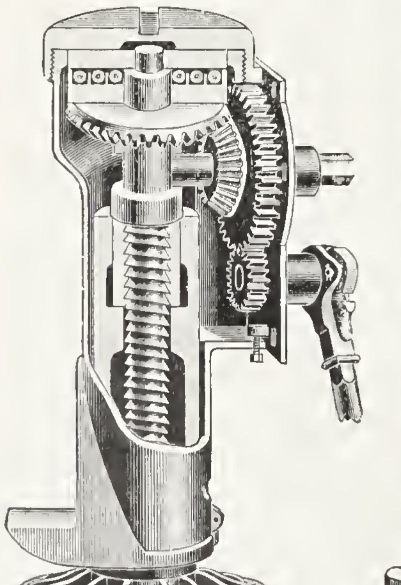

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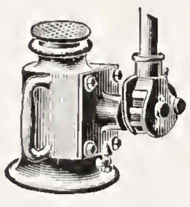

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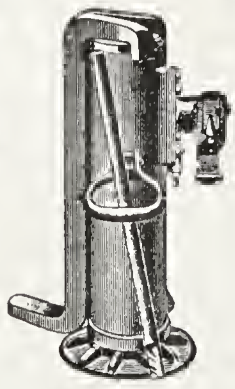

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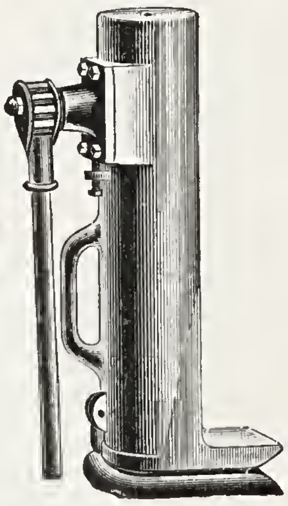

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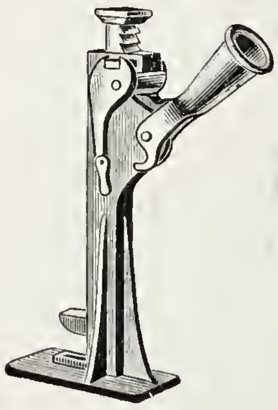

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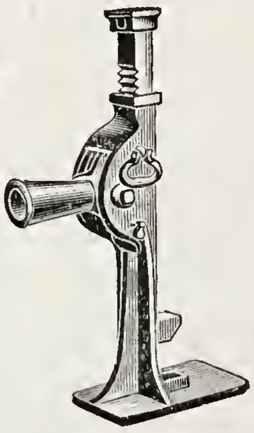

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The Canadian Engineer

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The Canadian Engineer.

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THE NEW POSTAL LAW.

The Hon. William Mulock comes within an ace of being a great postal reformer. Although not the originator of the Imperial penny postage, the ready co-operation he has given to the plans of the Imperial Government is appreciated throughout all the British Empire, he has brought about many economies in the administration of his department, and last of all, the domestic two-cent rate, which has just come into force in Canada, is the consummation that thousands have long devoutly wished. In order to cover up in part the deficiency which this reduction creates, he has framed a law imposing postage upon newspapers. With such a law in itself we have no fault to find. In fact, the publishers of this journal advocated such a law several years ago, before the present Postmaster-General came into office, but it is just in this law that the Hon. Mr. Mulock fails to be a great man, and discloses either the weakness or shadiness of his public career. The new law is in fact a deception, in that it allows one class of papers to get the benefit of postal service free as before, while it imposes the whole burden of the tax on another class of papers. Whether, as some suppose, the Postmaster-General was moved by a craven fear of the country Press, which forms, in numbers at least, the largest section of the newspapers of the Dominion, or whether he was moved by another motive, we cannot say, but the fact remains that this new law, by creating a zone of forty miles from the office of publication, within which all newspaper matter is free, relieves ninety-nine out of every hundred local papers from the payment of postage, while the newspapers that have a general circulation benefit practically nothing by this exemption.

The Monetary Times shows up the injustice of this arrangement by the following concrete instance: "We know of one case where a journal having a circulation of 4,500 will, by the operation of this Act, benefit to the extent of only 110 copies. On the other hand, a paper having a local circulation of an equal number would pay no postage at all. Mr. Mulock, we are assured, will see the injustice of such an arrangement." We sincerely share in this hope, for a discrimination so unjust was never framed in the history of newspaper laws. As before stated, the whole burden of this tax falls upon one class of newspapers, while another class is permitted to escape altogether. A law founded upon injustice cannot, and should not, stand, and we believe the Postmaster-General has a sufficient sense of right to see that this discrimination is removed.

OILING UP.

BY J. W. WILLIAMS.

In the broad range of the art of mechanics there is no more engaging feature than that of the problem of the reduction of waste power caused by friction, and the extent of these efforts may be measured by comparing the shrieking ox-cart of India and Africa and the ball-bearing axle of the present, with this great extent of improvement in mechanical construction there still remains one feature which seems to have been understood by the wagon driver of a thousand years ago just as simply and as clearly as the engineer of to-day, that is, lubrication. This is an item of knowledge as valuable as many of those which are incidental to machines of all kinds, and one which cannot be overlooked, both from a theoretical and practical value, as proper and improper lubrication raises and lowers the coal bill, and is an item of expense necessary to take into account. The main features of the operation of lubricating may be considered, the conditions and the material.

Attention may be given to the elements which constitute a plant. There is a source of power, a machine possessed of limited force usually in excess of the call or requirement, this may be an engine (steam, gas, or oil), water-wheel, motor, etc., and this machine has to exert its strength in moving the working parts of the plant, the machinery, and execute a varying amount of work. In the effort to overcome the resistance of this work is produced the friction referred to, this friction exists from two causes, the actual weight of the material of the machinery and the pull or stress due to the effort of the motive power to do the work; this latter is the main part of all the friction, the amount due to weight of machinery material becoming less in the ratio of motion at ordinary speeds. The possible loss of power may be imagined from the results of experiments which were tried with a cast iron shaft on a dry bell-metal bearing with the result of a loss of one-fifth of the power, with a wrought iron shaft a loss of one-fourth; these proportions were reduced by lubrication to six per cent. in the first instance and nine per cent.

in the second. These two examples should be sufficient to indicate that "oiling up" is an important part of the care of machinery.

The conditions may next be considered, and the first which presents itself is that of varying pressure and varying speeds and, as important to consider, varying temperature; these are the conditions under which a lubricant is required to work, and to meet these it should possess sufficient body to withstand pressure, and to be fluid and free running for speed. The qualities which we may look for in a lubricant are a freedom from injurious elements, abrading or corrosive, and having stability in that it will not solidify in the cold nor evaporate in the heat, this latter tendency producing two results, either the total loss of the lubricant, or what is called gumming, which is part of the lubricant evaporating and leaving the solid portion in the bearings; this latter is a characteristic of vegetable substances, the total evaporation occurring with mineral oils of light grade. The corrosive nature referred to occurs with animal products, these having a greater tendency to rancidity and also requiring more chemical treatment to bring into condition and thereby being in greater danger of being tainted with corrosive impurities.

We need not consider the long list of substances which have been used as lubricants, solid, liquid, dry, wet, thick, thin, clean and dirty, for all these have been features of the various lubricants which have had their place in the markets, but we may be satisfied that in the animal oils and greases, with their great range of body, their freedom from impairment by atmospheric action and other physical changes, that we may obtain a lubricant fitted especially for our requirements, but it lies with the users to examine them in practice for the features enumerated, and, what will be found the main cause of dissatisfaction, misuse of them must be corrected. It is within bounds to say that the use and not the stuff is what is wrong, and in this direction should improvement be sought, with a better attention to bearings to keep them *steadily* supplied; three cents a gallon cut obtained on an oil is nothing to boast of if thirty cents worth of coal be used instead of the oil.

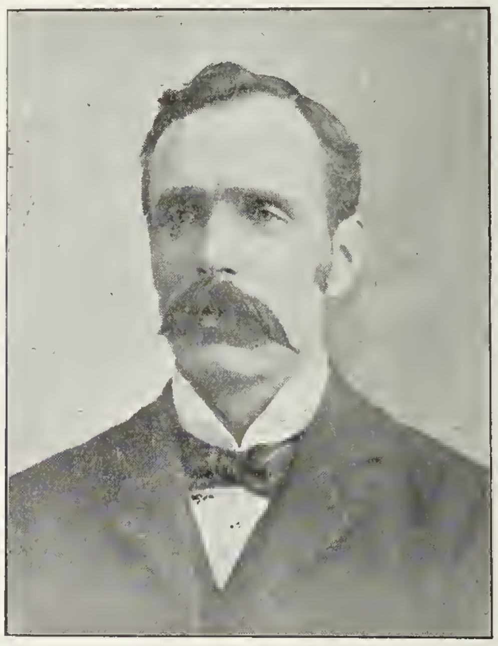
THE ELECTRIC LIGHTING OF TRAINS.

ROBERT A. ROSS, E.E.

Electric train-lighting is occupying the attention of the larger railway companies on this continent at present to a large extent, and in a number of cases has been adopted for the better class of train service. In Europe the development has been much more rapid and on many lines it has or is in process of displacing the oil and gas formerly in universal use. The reason for the change is not far to seek. The public demands the utmost luxury when traveling, and having been educated to the advantages of electric lighting at home is quick to appreciate the same advantages on the railways where at the present time it is counted a luxury, but will soon become a necessity. The public recognizes the fact that as the electric lamp is free from flame there is no risk of fire and no vitiated atmosphere to breathe and it has an illuminant and not a mere gloom disperser as with oil and gas. Its ready adaptability to being placed where wanted makes possible the use of reading lights in the seats and in other positions where any other form of illuminant would be impossible.

The railway companies are not slow to appreciate these advantages, but naturally wish to be assured that electrical illumination will not be more costly and less reliable than other methods. As regards the cost, from recent experiences of different companies it appears that it is at least as cheap as gas and more expensive than oil. That this inferiority in point of cost as compared with oil will not hinder its introduction is evident, for oil has superseded candles although more costly, and even if electric lighting were more expensive than gas its acknowledged superiority would render its use advisable. As regards reliability, which is certainly equally important with cost, the apparatus used in all systems of electric lighting is practically identical with that used for the illumination of buildings and should be as reliable in operation.

Storage batteries at the present time are thoroughly commercial, as are the dynamos and generating apparatus, In the case of axle driving some complication in the regulating apparatus may exist and it is particularly at this point that a careful selection of apparatus is essential. The several systems in practical operation may be divided into two general classes, the first where each car on the system is independent and capable of taking care of itself. and the second where each car is dependent upon some method of charging located either upon the train or at certain points along the line. The first class necessitates the use of an axle-driven dynamo under each car with sufficient storage battery capacity to carry the lights over the periods when the train is not in motion or running too slowly to enable the dynamo to light the car. Generally speaking the operations of this equipment is as follows: When the train is at rest or running under fifteen to twenty miles per hour the battery operates the lights, when the speed mentioned is reached the dynamo having attained the proper voltage is automatically connected to the lights and battery through the operation of a governor or electro magnetic mechanism, and the battery is charged and the lights operated from the dynamo. To regulate the voltage which would increase in proportion to the increase of speed of the train if not controlled, two general methods are adopted, either by keeping the speed of the dynamo constant or by regulating its field strength. The first is attained where the machine is belt-driven by allowing the belt to slip, the amount of slip being governed by some form of belt-tightening arrangement. This, while apparently unmechanical at first sight, works well in practice, and has the merit of extreme simplicity. Where the dynamo is rigidly geared to the axle the system of the regulation of the field strength to vary in inverse proportion to the speed is adopted, which may be done either by an automatically controlled resistance in the shunt field, by changing the resistance of the magnetic circuit of the field magnet, or by a system of differential field winding. By the above system each car is a separate and self-con-



JOHN GALT, C. E., CITY ENGINEER, OTTAWA.
A Biographical Sketch appeared in the December Issue.

tained unit and may be attached to any train on any line. Under the second class, where each car is not a separate unit but is dependent upon outside assistance, there are two general systems, the first where the car equipment consists of storage batteries alone, which are charged at suitable stations along the line, and second, where either an engine and dynamo unit driven by steam from the locomotive boiler or a separate boiler in the baggage car, or an axle-driven unit for the entire train is located in the baggage car. Where the simple storage system is used each car is dependent upon obtaining charged batteries at regular intervals and its travel is limited by this consideration. Where the baggage car equipment is used the train is the unit, and except for short intervals determined by the capacity of the battery installed on each car the unit must be maintained intact and the entire train must be wired, at least for the main conductors for through connection to the last coach. In the case of through trains, where the amount of disconnection is small during long runs, the batteries might be dispensed with and dependence placed upon the generating unit in the baggage car, or a single set of cells used in the baggage car or last car of the train to carry the lighting over the periods of disconnecting of the engine or baggage car.

As regards the initial cost of these several systems the writer, after a careful investigation of what has actually been done and what can be done at prevailing prices, has come to the conclusion that the order of cost is about as follows, beginning with the cheapest :

1. Engine and dynamo unit in baggage car without batteries.

2. Engine and dynamo unit in baggage car with batteries under each car.

3. Single axle unit in baggage car with cells under each car.

4. Battery equipments under each car with charging stations at intervals.

5. Separate axle units and batteries under each car.

The last two are not far apart in initial cost per car It may be pointed out, however, that allowance has been made for charging stations on the understanding that they are not used for other work, but in many cases the companies have lighting plants already established which are available for charging, which would diminish the cost of the charging station plan considerably. As regards reliability any of these systems to be commercially successful must be capable of being placed in the hands of the train crew, the supervision of experts being only available at large terminal points, and the expert supervision necessary should not be great even when available, and this will be secured by the use of the system which requires the least apparatus on the cars. This condition is best met by the charging station system where the batteries are inspected after each run and the charging apparatus is under competent supervision. The chances of failure are greatest on the systems employing the axle units for charging, but even in this case from the reports of several companies the failures are few. Regarding the comparative cost of operation of the various systems it is impossible to speak generally, as each is dependent upon the local conditions on the particular railway system under consideration. It may, however, be pointed out that the interest and depreciation accounts, if properly allowed for, will be the largest item in the cost, and the investment in the original instalation will to a large extent govern the annual cost per car for its operation. This acts against the charging station scheme because of the large number of batteries used, and on them the depreciation is larger than on the rest of the apparatus.

The voltage employed where batteries are used should be kept as low as possible with due regard to the wiring losses, to take advantage of high efficiency lamps and to reduce the weight and cost of the batteries as much as possible. In practice the voltages range from 24 to 60 and in many cases 2.5 watt lamps are adopted ; the decreased life of these being compensated for by the smaller size of battery and charging apparatus. Where axle units are used the problem to be met approximates in a small way to that of street railway motors which are operating under the floor of a moving car and subject to the shock and disturbance of the motion, but the amount of attention which they will receive while operating is less than in the case of the motor.

To sum up the relative advantages of the several systems in a general way we may say that the system employing a steam unit in the baggage car without batteries is the cheapest and is very simple in operation, but when the locomotive is uncoupled the lights are extinguished, for which reason batteries under each car are a necessity unless the train is never broken. The batteries need, however, be but small. A single axle unit in the baggage car is in a good position for operation without chance of failure, but requires somewhat larger batteries on each car than the steam unit system to carry the lights while the train is stopped or running slowly. Each of the above systems requires that the train be wired throughout from car to car. The advantage of the separate axle unit under each car is that each is independent and no through wiring is necessary, but the initial cost is higher, and the necessary supervision greater than those previously mentioned. The charging station plan is simpler in operation, but its initial cost is high, and its operating costs probably higher than any of the others for the same conditions. It may be pointed out that where any road is contemplating the use of electric light the natural course is to proceed cautiously and invest as little as possible until success has been demonstrated, and for this reason the separate axle unit has an advantage, as only those cars upon which the system is to be tried need be fitted up, while with the other systems expense has to be incurred for wiring all cars or establishing charging stations.

These are merely general views and should not be applied indiscriminately to all cases, as the local conditions of each road will modify the above conclusions profoundly, each case requiring a careful study of existing conditions to ensure that the best system is adopted to meet the requirements. Under the varied conditions of traffic each of the above systems has its place and with the possible conditions met by such varied systems it is not too much to hope that the train of the immediate future will be the electrically lighted.

THE EVILS OF INTERCEPTION TRAPS, ETC.

BY W. M. WATSON.

In the July issue of The Canadian Engineer I gave an epitome of the sanitary experiments carried out by the authorities of the city of Cologne, Germany, that proved that it was both dangerous to the public health and in direct opposition to sound sanitary science, to place interception traps on private drains and useless vent pipes on the interior house plumbing arrangements.

Another paper on "Sanitary Excesses" in your September issue showed that the engineers and surveyors of Old London who had pressed the American drainage obstruction system on their employers, the public authorities, plainly saw that a serious mistake had been made, and, that after the aerating advantages of the old draining system were discontinued, that all the public sewers and private drains were simply turned into putrefaction chambers or receptacles for breeding diseases, and that the foul gases generated in the sewers invaded the houses and streets, and that they, the engineers and surveyors, were meeting together to find out a plan to crawl out of the difficulty without tarnishing their former reputation.

The model by-laws, as they call them in Great Britain, or town laws compelling property owners to place the interception trap on their drains and to have useless vent or back air pipes attached to all the house traps, has only been enforced for a very short time, and in a few towns of Great Britain, but the injurious effect of such dangerous innovations was soon felt, because the people are more crowded together there than out here, and the highest sanitarians and engineers have begun to speak out boldly against such cruel and expensive model by-laws, and considerable valuable information has been published in the engineering and sanitary journals of Great Britain proving the injurious effects on the public health.

The lectures and debates of the 17th annual Congress of the members of the Society of Sanitary Science, held lately at Birmingham, England, dwelt largely on the evils of the interception trap and the excesses that have crept into plumbing and draining work. W. Henman, Esq., F.R I., B.A. Sc., etc., chairman of the Sanitary Section of the Congress, in his opening speech stated that the day would come when all interceptors and traps would be abolished, and with them the sewer gases which the interceptors had retained about our dwellings. He proved, during the delivery of his address, that public engineers and surveyors had deeply sinned against the public in the construction of public sewers, because, instead of aiding a rapid removal of sewage and refuse by water carriage, nearly all the sewers they constructed acted as filters or separators, invariably leaving the solids in the sewer pipes to fester and become offensive and dangerous to the public health.

Dr. Bostock Hill at the same meeting showed the falsity of using drain pipes too large for the flow and placing interception traps on the private drains. He stated that the smallest waste or drain pipes which will convey the necessary quantity of liquid intended to pass through are certainly the best for reasons of cleanliness and flushing. From a single house a 4-inch drain is ample, yet Mr. Bostock says he has known public surveyors insist on having a 6-inch pipe and interception trap installed instead of a 4-inch, stating that they compelled the larger pipe because there was less likelihood of the drain becoming choked, which cannot be true, and there are many other disadvantages that tell against using too large a drain pipe, viz., from small houses solids and sewage are chiefly sent down in gushes, the pipe itself, if it is 6 inches, can never be nearly full, and the crown and upper half of the sides only get splashed, so that dirt and filth accumulate and set up putrefaction and generate dangerous gases. Continuing his address on the interception trap he states that when the trap is put in the main line of the private drain a ventilation pipe has to be installed somewhere near the surface of the ground, near the house, to ventilate the private drain and house waste pipes, and in that case the following evils must of necessity occur, viz., each syphon or dip on the trap holds a quantity of foul water, and where water closets are used fœcal matter lodges in them, which generates poisonous gases that take the easiest way out to the open air, which is through this breather or private ventilation pipe. This same breather delivers the accumulated contents of putrid gases each time the house sewage is rushed down the waste pipes and private drain. By these two methods alone a large amount of putrid and poisonous gases are discharged into atmosphere near the windows and doors of private dwellings, causing constant smells, and if some of the dwellings have fever in the place, and the stool of the patient is sent down the sewer, then the foul gases discharged from the breather pipe or air inlet at this time is dangerous and will spread the epidemic. It is certainly undesirable to store sewage even in such small quantities as the amount that lodges in the dip of a trap near inhabitable premises, and I am strongly of opinion that the system of placing interception traps and other impediments in waste and sewer pipes induces a state of things that, from a sanitary point of view, is very much worse than the system which the modern model by-laws have superseded. These are the opinions of a public health officer in England, and many of his associates are fully in accord with him, but I will not weary the readers with repeating their speeches, but proceed to give the results of the tests made by Dr. Porter, M.D., showing the resistance of traps to the freedom of the flow of water and solids when flushing water closets, because it is further extending the experiments begun at Cologne and proving another reason why their adoption is injurious to the public health. Dr. Porter shows by his experiments, what amount of water it takes to flush a water closet properly and prevent the private drain from becoming little better than an elongated cesspool, and states that to gain a thorough knowledge of the requirements of house drains he made 120 test experiments by flushing on the lines laid down for such purposes by the Sanitary Institute in 1893. The class of water closet he used was Duckett's wash-down closet having an S trap and a Unitas washout closet, flushed by a water waste preventing cistern graduated for a flush of 6, 4, 3½, 3, 2½ and 1½ gallons of water at one flushing, and connected to the basin by 5 feet of 1¼-inch lead pipe. The water closet in each case discharging through 47 feet of glazed earthenware 6-inch pipe and again through the same length of 4-inch tile piping to an interception trap, the usual quantity of fœcal matter and paper used being supplied from a factory privy. The weight of the quantities at one flushing being 4 ounces, 6 ounces, and in a few trials 8 and 12 ounces used at each flushing. The first series of trials (fifty in number) were made with a 4-inch drain (fall 1 in 40) and 4-inch disconnecting trap. This trap was filled by 4 pints of water and at the lowest part measured 3½ inches transversely and 4 inches vertically. Flushes of 3, 2½, 2 and 1½ gallons were employed, the result being that 3 gallons invariably sufficed to thoroughly flush closet, drain and 4-inch trap; a 2½ gallon flush generally failed to clear the 4-inch trap; with 2 gallons the interceptor was not once cleared, and most of the solids were left in the trap. By repeated 2-gallon flushes in rapid succession, causing a head of water in the drain, the trap was eventually cleared with a rush, but this did not happen if one flush were allowed to trickle away before the next followed it. A 1½-gallon flush was found to be of little use. The drain was never cleared and became rapidly blocked.

The second series included twenty-one experiments, and was made with a 6-inch drain (fall 1 in 60) and 6-inch disconnecting trap, which, it is noteworthy, required 12 pints of water to fill it, and at its lowest part measured 5⅛ inches transversely and 5⅜ inches vertically. Flushes of 6, 4, 3½, 3 and 2½ gallons were used, and it is a remarkable fact that, though 3 gallons and upwards sufficed to clear the closet and drain each time, the 6-inch trap was cleared by a 6-gallon flush in only two out of four cases ; 4 gallons cleared it in only one out of six cases, and anything less than 4 gallons altogether repeatedly failed to clear the trap.

The third series numbered twenty-two experiments with a 6-inch drain and a 4-inch intercepting trap. With a 3-gallon flush the closet, drain and trap were efficiently cleansed every time, but a flush of less than 3 gallons failed each time to clear the drain and to reach the trap.

The fourth series (eighteen trials) with a "Unitas" washout closet, 4-inch drain and 4-inch interceptor, flushes of 3, 2½ and 2 gallons being used ; 3 gallons sufficed to clear the trap in two out of six cases. With smaller flushes the trap retained a portion of the charge in every case ; in five cases the drain was not cleared, whilst in eight the closet trap was not cleared, due evidently to the inherent faults of the washout closet. I shall be pleased to supply fuller details of these results to anyone interested in the matter, and I venture to submit the following

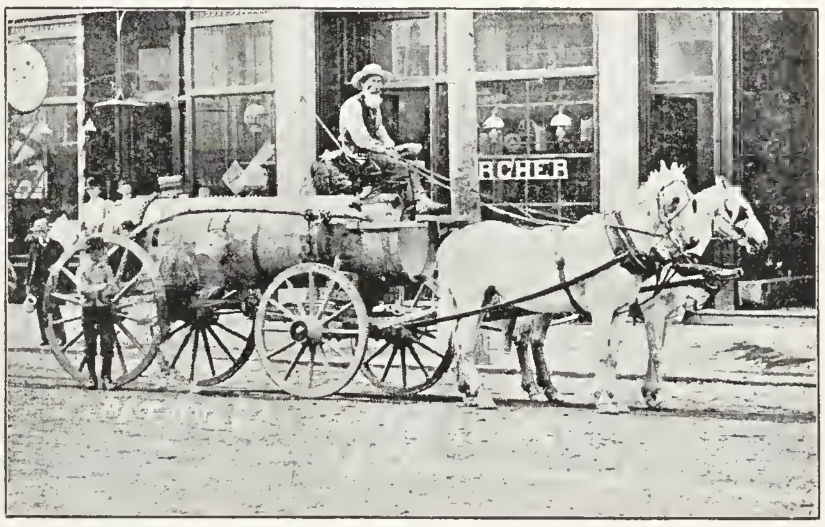
CONCLUSIONS.

(1) That 3 gallons is the minimum amount that can be relied upon for efficient flushing—*i.e.*, prompt carriage of dejecta through closet, drain and interceptor to sewer even with a good form of washdown closet well laid, 4-inch or 6-inch drain, and good 4-inch interceptor. (2) That if an inferior type closet be used, or if the intercepting trap exceed 4 inches in diameter, 3 gallons is clearly not sufficient for effecting flushing. The proper remedy then, however, is to correct such structural deficiencies rather than to increase the flush. (3) That if no intercepting trap be employed a flush of 2½ gallons is the minimum amount that can be relied upon to efficiently cleanse the closet trap and drain. (4) That the invariable employment of a disconnecting trap, as recommended by the model by-laws, is far from being an unmixed benefit, and, owing to the obstacle the disconnecting trap presents to the cleansing of house drains, its use should be strictly limited to those dwellings inside which a drain opening exists—*e.g.*, in the cellar—and that if such drain openings inside houses were prohibited in new dwellings, disconnecting traps might, with great advantage, be entirely dispensed with. There is much reason to believe that we have hitherto exaggerated the potency of sewer air ; assuming, however, that it is noxious in its effects, the object of a disconnecting trap is wholly gone if we keep all drain openings outside our dwellings ; and having done this, it is absurd to continue to insist on disconnecting traps, which only diminish the efficiency of the flush of water.

This is the opinion of Dr. Porter, an eminent authority on sanitary matters. If our readers turn up the back number of April, 1897, they will find an article on sanitary appliances, showing how cellars and basements can be properly drained without the drain entering the premises. this is the way Dr. Porter suggests they should be.

PETROLEA WATERWORKS.

The Board of Water Commissioners, Petrolea, Ont., has presented a statement of receipts and expenditures for the year ending November 30th, 1898, that is most encouraging, and considering the prospects for the future the chances are that next year the works will be self-sustaining. These works were constructed in 1896 and 1897, and have been in continuous operation since January, 1897, although not fully completed until a few months later ; they were fully described in THE CANADIAN ENGINEER for November, 1897. Few people, even in Petrolea, believed that a town of less than 6,000 population could afford to spend $172,000 on a waterworks system, and many prophesied that the works would not only be a failure financially, but that they would not be a success mechanically. The town engaged as engineer Willis Chipman, of Toronto, to design the system and to superintend construction. The cost was kept well within the estimates and within the amount raised by the sale of the debentures. Not only has the cost of all the service pipes, but the cost of all the extensions of mains laid in 1897 and 1898 has been paid out of the amount raised by the sale of original debentures.



PETROLIA WATER WORKS, 1890.

The town of Petrolea in 1893 entered into an agreement with a private company to put in works on the franchise plan, but the company not succeeding in finding an available source of supply near the town failed to complete the works after laying two miles of pipes. By this agreement the town was to pay $4,900 per year for 70 fire hydrants. Upon the recommendation of their engineer in 1895 the town decided to construct its own works and go to Lake Huron for its water supply, a distance of twelve miles in a straight line from the town hall, pumping the water over a rise of 150 feet above the lake to a water tower in the town, its base being 87 feet above the lake level. The size of the main to be laid from the lake to the town, the protection of the intake on the fully exposed lake shore, the class of machinery required and the probable necessity of filtration, were all important problems with the town council, and other engineers were called in to report upon the plans, but their recommendations were not followed and the works were constructed as originally designed. The intake has now stood two winters without injury, the water supplied has given the best of satisfaction to the citizens, the cost of pumping, owing to the high class of machinery adopted, has been no greater than in many other places where the pumping station is not distant more than a mile from the town, and there have been no breakdowns since the works were started.

The commissioners report the receipts from consumers as $8,800 and they allow for fire hydrants only $4,000; making a total revenue of $12,800 for the year ending November 1st, 1898. The operating expenses for the year have been $3,560, leaving a balance of $9,240. The interest and sinking fund charges amount to $9,947 per year, and the net revenue is now $9,240. If the amount the town agreed to pay the private company for fire protection were substituted for the $4,000 the works would now be self-sustaining, and it is evident that in a year or more they will be so even with the present allowance for fire protection.

With the present low rate of interest for municipal debentures every town can afford to construct a system of waterworks, but it will be found to pay to put in a general sewerage system at the same time.

ONTARIO WATER WORKS SYSTEMS.

We are indebted to Willis Chipman, C.E., Toronto, for data upon which the following valuable tabular history of water works systems of urban municipalities in Ontario for the past fifteen years has been compiled. Cities of 20,000 and over, in which large sums had been spent in a long series of years previously, have been omitted. A separate list is given of water works constructed by private corporations and afterwards acquired by the municipalities; and of water works built by private companies and still operated by such companies. The list will be a valuable one for reference purposes.

WATER WORKS BUILT BY MUNICIPALITIES.

	Pop.	Date	Cost.	Engineer.
Alexandria........	1,700	1895	$23,000	Potter, Alex.
Amherstburg......	2,300	1891	25,000	Galt, John
Aylmer	2,200	1891	17,000	Milne, Alex.
Alliston	1,400	1892	......	....
Beamsville	900	1895	14,000	....
Beeton	800	1892	20,000	Galt John
Bracebridge	1,400	1894	20,000	Brough, W. C.
Brampton	2,500	1882	65 000	....
Brantford	17,000	1888	230 000	Cole, J A., & Jones, T. H.
(Small works, built by a private company for fire protection, were purchased by the city in 1888).				
Cambellford	2,500	1890	19,000	Galt, John
Collingwood	5,000	1890	79,000	Galt, John
Deseronto	3,500	1896	35,000	Butler, M. J.
Dunnville	1,800	1891	5,000	Galt, John
Essex	1,700	1891	31,000	Galt, John
Fort William	3,000	1898	36,000	Galt, John
Galt..............	7,000	1891	157,000	Chipman, Willis
Gananoque	3,000	1892	20,000	Chipman, Willis
Goderich	4,000	1888	68,000	Chipman, Willis
Georgetown	1,500	1891	40,000	Warren, Jas.
Huntsville	1,200	1897	20,000	Roberts, V. M.
Kingsville	1,400	1894	......	Newman, Wm.
Leamington	1,900	1891	16,000	Bell, J A.
Markham	1,100	1891	10,000	....
Meaford	2,000	1892	22,000	Sing, J. G.
Merritton	2,000	1888	78,000	Monro, Thos.
Milton............	1,500	1888	20,000	Bell, J. A.
Morrisburg	2,000	1887	26,000	Kennedy, Wm.
Mt. Forest........	....	1898	25,000	Galt, John
Newmarket	2,200	1886	20,000	....
Niagara Falls	4,000	1890	77,000	Kennedy, Wm.
(The original works, built and owned by a company, were purchased by the town in the year given, and the works rebuilt and extended).				
Niagara-on-the-Lake	12,500	....	35 000	Galt, John
North Bay........	2,000	1892	38,000	Galt & Rourke
North Toronto	3 000	1892	40,000	Venables, J.
Orangeville	4,000	1895	50 000	Chipman, Willis
(Small works built originally for fire protection on the main streets. Rebuilt and enlarged in year given).				
Orillia	5,000	1892	.. ..	....
Owen Sound	7,000	1890	125,000	Kennedy, Wm.
(The original works, built and owned by a company, were purchased by the town in the year given, and the works rebuilt and extended).				
Paris	3,500	1884	40,000	Bell, J. A.
Parry Sound	2,000	1892	35,000	Galt, John
Penetanguishene ..	2,200	1891	30,000	Galt, John
Pembroke	4,500	1893	56,000	Chipman, Willis
Petrolea	6,000	1896-7	170,000	Chipman, Willis
Picton	3,300	1889	33,000	Bolger, T.
Port Colborne	1,500	1898	16,000	Witmer, J. F.
Port Hope........	6,000	1895	50,000	Stuart, J.
(Small works built originally for fire protection on main streets. Rebuilt and enlarged in year given).				
Renfrew	3,000	1897	52,000	Chipman, Willis
Sandwich	1,500	1891	19 000	....
Shelburne	1,200	1890	13,000	....
Stouffville	1,400	1897	22,000	Galt, John
St. Thomas	11,000	1891	150,000	Bell, J. A.
(The original works, built and owned by a company, were purchased by the town in the year given, and the works rebuilt and extended).				
Sudbury	1,400	1896	......	Gordon & Rourke
Tilbury Centre....	800	1888	16,000	....
Toronto Junction..	5,000	1889	180,000	Venables, J.
Welland	2,500	1888	32,000	Kennedy, Wm.
Wiarton	2,000	1889	30,000	Ronald, J. D.
Woodstock........	9,000	1892	150,000	Keefer, T. C., & Davis, W. M.
(The original works, constructed for fire protection, were rebuilt by the town in 1892).				

WATER WORKS BUILT BY PRIVATE COMPANIES AND ACQUIRED BY THE MUNICIPALITIES.

	Pop.	Date.	
Barrie	6,000	1891	Town purchased in 1898 for $78,000. Willis Chipman, engineer for town.
Berlin	8,000	1888	Town purchased in 1898 for $102,000. Willis Chipman and H. J. Bowman, engineers for town.
Brantford	17,000	1870	Purchased by the city for $63,000.
Brockville	9,000	1884	Town purchased in 1882 for $129,000. Willis Chipman, engineer for town.
Chatham	9,000	1891	Town purchased in 1895.
Cornwall	7,000	1886	Town purchased in 1887 for $86,000. Willis Chipman, engineer for town.
Kincardine	2,600	1890	Purchased by town in 1894 for $45,000.
Niagara Falls..	4,000	1884	Purchased by the town for $17,000.
Owen Sound ..	7,000	1880	Purchased by town for $35,000.

WATER WORKS BUILT BY COMPANIES BUT NOT YET ACQUIRED.

	Pop.	Date.	
Belleville	10,000	1888	City now negotiating to purchase.
Cobourg	5,000	1888	....
Iroquois	1,500	1886	....
Ingersoll	4,000	1891	....
Lindsay	6,500	1892	....
Napanee	4,000	1888	....
Perth	3,500	1897	....
Waterloo	3,000	1889	....

CARBOLITE.

Of "Carbolite," the recent invention of Hartenstein, of which accounts have been published in the technical papers, The Engineering and Mining Journal says: "The material which he produces and calls carbolite is a biproduct in iron smelting, and is claimed to be a cheap substitute for calcium carbide, being of the same nature as the latter; it is claimed that the profit in producing it from blast-furnace slag promises to be so great that the pig iron may then be regarded as a biproduct. It is a calcium-aluminum-silicon-carbide. The slag is taken directly from the furnace blast in converters like those used in steel-making, impregnated with pulverized coke by means of a gas-blast, and the mixture brought into contact with carbon bars through which a current of electricity is passed, which generates the intense heat required to produce the carbide. It is shown that these claims are misleading. Such slags contain at most only 50 per cent. of lime, and the carbide thus produced would be very poor substitute for the calcium carbide; the silicon in the slag would form carborundum, which gives off no gas on the addition of water; the aluminum would form aluminum carbide, which, with water, evolves the methane, which is only faintly luminous, it being like natural gas; the iron oxide would form iron carbide, and would add another impurity. The mixture would therefore contain so many non-gas-making impurities that it would only produce a small amount of illuminating gas as compared with the calcium carbide. Moreover, the production of these useless impurities costs electrical energy, and it is doubtful whether the saving in heat due to using the already heated product would offset the waste of electric power. It is, moreover, doubtful if this material could be made without infringing on one or more existing patents.

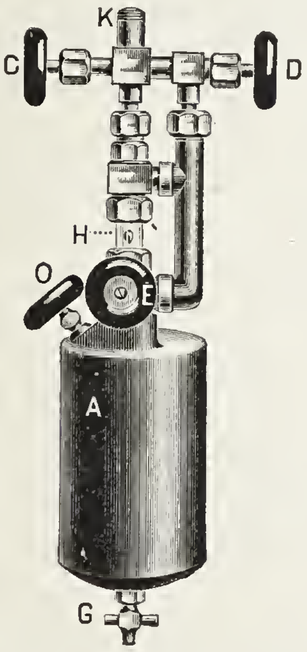
CANADIAN SOCIETY OF CIVIL ENGINEERS.

The thirteenth annual meeting for the election of the council for 1899, and the transaction of other business, was being held in the Society's rooms, 112 Mansfield street, Montreal, as we went to press; a full report of the meeting will appear in the February issue of The Canadian Engineer. The following is the programme: Tuesday, January 10th.—11 a. m., meeting for the election of scrutineers in the Society's rooms; 2 p.m., excursion from the Bonaventure depot to the New Victoria bridge, by courtesy of the Grand Trunk Railway; 8 p.m., meeting in the

Society's rooms, paper upon the construction of the new Victoria bridge prepared under the direction of Joseph Hobson, chief engineer, Grand Trunk Railway, illustrated by lantern projections. Wednesday, January 11th.—Excursion of the Society to visit the works of the Laurentide Pulp Company, Grand Mere, for which a courteous invitation has been extended by the company. Thursday, January 12th.—10 a.m. and 2 p.m., technical meetings in the Society's rooms, at which the following illustrated papers will be read: The Soulanges Canal, by Thos. Monro, past president, Can. Soc. C.E.; the Trent Canal by R. B. Rogers, M. Can. Soc. C.E.; the Georgian Bay and Ottawa Ship Canal by H. K. Wicksteed, M. Can. Soc. C.E.; 8 p.m., members' annual dinner, at the Windsor hotel. Friday, January 13th.—10 a.m. and 2 p.m., business meeting and an address by the retiring president, W. G. McN. Thompson.

THE PREVENTION OF SCALE IN BOILERS.

In an article in the November issue of The Home Study Magazine, in answer to the question, "Will carbonate of soda or plain soda remove hard sulphate of lime scale?" the expert replies, "I have never found it to be much good for that purpose. I can tell you, however, what will remove it pretty effectually—very cheaply too—and that is ordinary kerosene. If this is fed to the boiler at the rate of about one-quart per day per 100 h.p., the benefit to the boiler will soon be apparent. It has also been found to prevent, to quite an appreciable extent, the formation of hard scale. Its action upon the sulphate of lime does not seem to be a chemical one, however, but rather a mechanical action. In my opinion, the minute particles of sulphate of lime precipitated by the action of heat, are first carried to the surface of the water by the boiling and bubbling of the water. There they become coated over with the kerosene, which prevents them from uniting into a solid mass when deposited on the plates." This may be accepted as the opinion of one of the most advanced United States engineers it is claimed. In order to get the benefit of the scale removing properties of kerosene, it is necessary to introduce it into the boiler drop by drop, and for this purpose a special device has been constructed. One of the best known and most widely used of these is that shown in the accompanying cut, made by the Detroit Lubricator Co., of Detroit, Mich., and known as the Detroit Kerosene Oil Injector. Besides being extensively used in the United States, several thousand of them have been sold in Europe. For more than two years past the Vienna Dampfkessel untersuchungs und Versicherungs-Gesellschaft have been conducting a series of experiments with these Detroit kerosene oil injectors, and their report has recently been published. It agrees with the American opinion cited above, but it is more detailed and specific. It states, for instance, that "kerosene injected by way of drops with the feed water comes into the boiler as an emulsion, and remains waving in the water. The evaporating process separates the pulverized scale, which gets covered with a thin hide of oil, whereby the sticking to the wall is diminished." In regard to its action on the scale already formed, a very interesting explanation is given. On account of its peculiar nature, the kerosene penetrates into the scale, which being a very bad conductor of heat, is much hotter at the shell than on the water side. As the minute penetrating particles of kerosene get deeper into the scale they become hotter and hotter, till finally they become changed into a gas, and the resulting expansion bursts off pieces of the scale, just as dynamite does in a mine, and this process continues until all the scale is removed. As scale is one of the most annoying troubles of steam plants everywhere, this method of disposing of it, being both cheap and effective, will doubtless be very generally taken advantage of.



ELECTRICAL POWER TRANSMISSIONS.*

BY R. A. ROSS, E.E., M. CAN. SOC. C.E.

(Concluded).

Having sketched in a general way the points to be considered and determined upon the general features of the transmission, we may take up the figuring of lines, efficiencies and horse-powers to be generated. To do this, certain assumptions must be made as to the allowable efficiencies of the line and apparatus at various loads, which has been done in the tables below. As regards the apparatus, commercial efficiencies have been assumed, which are usual for this class of work, and will be guaranteed by the manufacturers. The line efficiencies are what would be usually allowed, considering the copper as designed for those efficiencies at maximum demand.

	Loads.			
Transmission (generator to sub-station)........................	100%	75%	50%	25%
Generators..............................	96	95	94	90
Line....................................	90	92.5	95	97.5
Raising and lowering transformers.	96	95	94	90
Total efficiency of transmission	83	83	84	79
Incandescent (distribution to lamps).				
Primary distribution at 2,000 volts..	96	97	98	99
Large reducing transformers... .	97	97.5	97	95
Secondary distribution to lamps . .	97	98	98.5	99
Total efficiency of distribution.	91	92.5	93.5	93
Arc Lighting (distribution to lamps).				
Efficiency of motor..	92			
Efficiency of arc machine..	86			
Efficiency of line distribution to lamps..........................	93			
Total efficiency of distribution .	72.6			
Power Circuit (distribution to motors).				
Efficiency of lines...	90	92.5	95	97.5
Efficiency of transformers...	96	95	94	92
Total efficiency of distribution	86.4	88	87	89.7
Railway Power (distribution to motors).				
Efficiency of rotary transformers. .	96	96	95	90
Efficiency of distributing lines to motors....	80	85	90	95
Total efficiency of distribution.	76.8	81.6	85,5	85.5

From these efficiencies of line and apparatus the whole power necessary for all the maximum demands may be transmitted at an efficiency of 80% from the generator shaft to the distributing lines in the city. The total efficiency at full load from the generator shaft to the lamps, railway and stationary motors, is 68%, and under the average running conditions would not be less than 70%.

These figures illustrate the remarkable efficiency of electrical transmission even on such a mixed and varying load. It will be noticed that at varying loads the efficiencies are not very different, owing to the fact that, while the apparatus falls off, the line increases in efficiency, thus maintaining a balance. In fact, under light loads the efficiency is higher than under heavy, and is actually higher than given in the totals, because the tables consider the whole plant as operating at fractional load, while in actual running the apparatus would be kept at full load by shutting down units as the load dropped, thus raising the efficiency. The figure of 68% therefore may be safely taken as the lowest to be met with during the course of the year, and as it holds only for the peak of the load will not affect the average efficiency materially. The date assumed or calculated for the transmission is given below. The power is that necessary at the distributing lines to take care of the maximum demands as shown on the curve of total power. The power factor is assumed to be 100% for the class of load considered, loss in transformers 4%, in line 10%, which is not too high for the peak of the load, as this is what the line is designed for.

Electrical H.P. required at end of transmission line	11,946
Voltage of transmission at end of transmission line	15,000
Periodicity or complete cycles per second	60
Distance transmitted in miles	10
Power factor assumed p. c.	100
Loss in transformers p. c.	4
Loss in line p. c.	10
System of transmission—Three phase	

Figuring the transmission on the above assumptions the actual electrical horse-power at the generator terminals is 13,623, while the apparent horse-power as read by volts and amperes is 13,862. In other words, while the real loss in the transmission is 14% of the power required at the end of the line, the apparent loss is 16%. This shows a high power factor for the whole system, and is obtained by a non-inductive load on a line well sub-divided, and with the wires properly placed.

To illustrate the effect of an inductive load upon the amount of apparatus necessary, another line with a load power factor of 90% has been figured, the other conditions remaining the same as before. This, while having the same losses as in the first case, requires 17,327 apparent horse-power at the generator, necessitating an increase of generating apparatus of 25%, or, in case the plant were installed, it would cut down its capacity 20%, and would decrease that of the distributing apparatus 10%. Were it not for these induction effects the problem would be as simple as in the case of direct current work, but as it is, they affect the matter to a very great degree, and require the most careful consideration to arrive at even a fair approximation to actual results.

Considering the fact that this power is laid down from the wheels with such simple machinery with but at most one revolving part, and therefore requiring no attention when once started, it is not surprising that electricity should have monopolized the field. The efforts at the present time to transmit to longer distances will be successful in proportion as the knowledge of insulating methods increases; and, from the rapidity with which present voltages have been attained from lower formerly prevailing, it is not difficult to foresee the time when this country which is so rich in water-power, will be literally covered with power lines for all purposes. The possibilities in the way of covering an increased territory by raising the voltage may be illustrated by the plant considered above, where, with 15,000 volt and 14% loss, the power covers a radius of ten miles in all directions. If the voltage were doubled, and the same loss allowed, the radius would be 40 miles, and the territory covered would be sixteen times as great. In other words the area served will vary as the fourth power of the ratio of increase of voltage. The question of the advisability of transmitting from a distance the natural power available in preference to generation at the centre of distribution by steam-power requires the most careful attention. The cost of the power laid down on the consumer's premises is made up of two items, namely, fixed charges and operating expenses. The first includes interest and depreciation on the plant, the second coal and supplies, attendance, etc. The saving by adoption of water-power is in coal and supplies, and perhaps a small part of the labor, provided the plant cost the same. Should, however, the cost of the transmission scheme be enough larger than that of the steam to eat up the saving in interest and depreciation on the increased cost of plant there is nothing to be said in favor of the transmission. If there is no cheapening of cost, the steam plant has the advantage of the greater reliability in lines and apparatus, as no high voltages need be used, and there is no risk of troubles with the water-power during the winter such as always exists to a greater or less extent in this climate.

In many cases, however, where the water-power improvement can be made with small outlay per horse-power rendered available, the gain may be large. It is not so large, however, as seems to be the idea of the public, which considers a water-power as capable of producing power for nothing, entirely ignoring the capitalization necessary for development. The transmission and utilization of electric power has got beyond the experimental stage, and is now surrounded with that mystery which used to obscure the financial facts, and the more it is considered as a commercial article depending upon the laws of supply and demand for its existence the more will its usefulness become apparent to the consumer and its financial security appeal to the capitalist.

MECHANICAL DRAFT FOR STEAM BOILERS.*

BY WALTER B. SNOW.

(Concluded from last issue).

We may now consider the influence, from a commercial standpoint, which the application of mechanical draft exerts upon the aggregate first cost of a steam-boiler plant. For this purpose there has been selected a plant of reasonable size of which the detailed cost is known. This plant consists of eight modern water-tube boilers, each of 200 horse-power nominal rating. A chimney is provided, 8 feet in internal diameter, by 180 feet high, of sufficient capacity to overcome the resistance of the two feed-water economizers and produce the draft necessary for any probable forcing of the boilers. The detailed cost of that portion of the plant which concerns the present discussion is in round numbers, as shown:

Eight water-tube boilers, of 200 horse-power each	$25,000
Two feed-water economizers	7,000
Boiler and economizer setting and by-pass	6,000
Automatic damper regulator and dampers	300
Chimney, complete	9,000
Building, complete	11,000
	$58,300

We may then consider the simplified arrangement which is possible when an induced mechanical draft apparatus is substituted for the chimney. There are two fans supported by the economizers, each driven by a separate engine. Each fan is capable of independently producing the draft for the entire plant, and thus serves as a relay is desired. Such an apparatus, with the short stack, can be installed, complete, under ordinary conditions, for about $3,500, making a saving of $5,800.

The omission of one boiler would bring the rated capacity down to 1,400 horse-power, and would call upon the fans to only increase the steaming capacity of the other boilers by about 14 per cent. above the normal, which could be readily done. This would show an additional saving in first cost which may be thus presented:

1,600 NOMINAL HORSE-POWER PLANT.

Cost of 8 boilers	$25,000
Cost of settings, etc.	6,000
Cost of building	11,000
	$42,000

1,400 NOMINAL HORSE-POWER PLANT.

Cost of 7 boilers	$21,875
Cost of settings, etc., about	5,500
Cost of building, about	10,500
Saving by use of mechanical draft	4,125
	$42,000

This shows a possible supplementary saving on the entire plant of $4,125, which makes a total reduction of $9,925 to be credited to the account of the mechanical method.

In any properly arranged plant the exhaust steam from the fan engine would be utilized so that the actual cost of the steam used in producing draft would be reduced to practically nothing. The value of the land may be an important factor in first cost. If figured at $2 per square foot, for instance, the omission of the chimney would in this case save $990, and the reduction in the number of boilers, $960 on the cost of the land required for the plant. The total net saving in first cost of a single plant, under the given conditions, may be thus summarized:

By omission of chimney and damper regulator	$ 5,800
By reduction in number of boilers	4,125
By saving in space occupied by chimney	990
By saving in space occupied by boiler omitted	960
	$11,875

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*Abstract of a lecture delivered before Sibley College, Cornell University

This total saving is made possible by the expenditure of $3,500 for the mechanical draft apparatus; that is, the saving is nearly three and one-half times the expenditure necessary to secure it. The reduction of $11,875 in the cost would indicate an annual saving in fixed charges of about $831 to $890, according as the aggregate of interest, taxes and insurance is taken at 7 or 7½ per cent. This amount would, under conditions of the best economy, be practically sufficient to cover the cost of operating the mechanical draft apparatus, provided no attempt was made to utilize the exhaust steam, and would far more than cover it were this steam usefully employed. When to the economical advantages already pointed out is added the increased convenience of mechanical draft, its positive character, its ready adaptability,' its independence of climate conditions, and its instant response to any demand for increased steam supply, the account stands decidedly to its credit. Therefore any further saving, as for instance in the cost of the fuel burned, is clear gain over and above any expenditure that may have been made on account of the introduction of this method. As a further factor in the matter of cost it should be noted that the fan possesses a definite advantage over the chimney in that it is portable and is always a valuable asset. The chimney, on the other hand, is a fixture; it is suited only to certain conditions and is practically valueless unless those conditions exist. The ability to utilize cheap fuels is an inherent advantage of mechanical draft, due to the fact that such fuels, being as a rule finely divided, with a large percentage of dirt and ash, require an intense draft for their combustion.

The influence of mechanical draft upon the quality and cost of the coal required is well exemplified in the case of a plant, consisting of three Babcock & Wilcox boilers of 335 h.p. each. The draft is furnished by a blower, which forces the air to the ashpits, and whose speed is automatically regulated by a special device, so that the volume of air and intensity of draft are continually changing to suit the varied conditions and requirements of the fire. Before this mechanical draft plant was put into operation, the fuel employed was George's Creek Cumberland coal, costing $4 per ton delivered. Since the fan has been in use, the quality and price of the fuel has been reduced to a mixture of No. 2 buckwheat with yard screenings and Cumberland, costing $2.62 per ton. The present average saving per week is over $126, when all fuel, including that for banking fires, is taken into account. Finally, in addition to the economic advantages of mechanical draft which have been presented, there are others which relate primarily to the convenience of installation and operation. Prominent among these is the feature of adaptability. The fan, which is usually of steel plate, may be constructed in any shape to meet specific requirements, may be located as desired with regard to the position of the boilers and without expensive foundations, may be used for either forced or induced draft, and because of its portability may be relocated or exchanged for another of different capacity. In its operation the fan is perfectly flexible, may be run at high or low speed, independently of the chimney temperature, and is always susceptible of instantaneous change in response to sudden demands. A mere change in engine cut-off produces an effect only secured with a chimney by adding to its height at great expense. External temperature changes have no appreciable effect upon the operation of mechanical draft, which, above all else, is independent of climatic conditions. The fan is a most important factor in smoke prevention, and in connection with the closed fire-room system the resulting ventilation is of vital importance. Briefly summarized, mechanical draft has here been shown to be capable of reducing the avoidable losses, of decreasing the first cost of a steam generating plant, and of reducing the fuel expense. In addition, it presents certain marked conveniences in the matter of installation and operation. In these days when every step in the process of steam generation and utilization is being scrutinized in the attempt to reduce the cost by even a single per cent. the opportunity presented by the employment of mechanical draft cannot be and is not overlooked. The economical necessity was not so imperative when Rankine and Clark pointed to its marked advantages. And the future was but dimly discerned when, only fifteen years ago, Seaton referred to the chimney as a rough and ready, but exceedingly wasteful way of inducing the air to flow into furnaces with sufficient velocity to cause the fuel to burn, and prophesied that it would some day undoubtedly be superseded by a more scientific and economical apparatus. Mechanical draft now stands so well established in the engineering world as to lead a noted engineer to remark that, "the building of tall chimneys to secure draft simply advertises the owner's lack of familiarity with modern improvements, or his want of confidence in results easily demonstrated."

A NOVEL METHOD OF SEWAGE DISPOSAL, ESPECIALLY DESIGNED FOR THE CITY OF TORONTO.

BY C. G. HORETZKY, C.E.

Upon the assumption of a present population of 200,000 inhabitants,, the city of Toronto pours daily into the bay, and deposits upon the water front directly under the noses of her citizens, and beneath the keels of steamers and other craft frequenting the wharves, twenty tons of solid faecal matter, aggregating, during a year, the enormous quantity of 7,300 tons. To this must be added the solid excrementitious matter derived from stables, byres, slaughter-houses, and other extraneous sources, together with 16,000,000 gallons of excremental and other foul liquids. With the view of ameliorating the present conditions, C. H. Rust, city engineer, in his report of October 12th last, has recommended either of two methods of sewage treatment, i.e., intermittent filtration, the cost of which is estimated to be $730,000; or chemical precipitation, followed by filtration, presumably, through natural soil, at a cost of $550,000. The first mentioned process is estimated to involve an annual charge for maintenance of $70,000; the latter $105,000. Owing to the fact that, under the auspices of the Provincial Government of Ontario, the writer has been the pioneer of sewage treatment in Canada, that he has examined many of the best known plants in the United States, that he is in constant communication with United States State Boards, and is consequently in a position to be informed of the latest methods pursued there, it seems pardonable, in the interests of the community, to throw some additional light upon the very important question of the sewage disposal of this city.

Some time ago I outlined briefly in the columns of The Toronto Globe a method for the partial purification and disposal of the Toronto sewage. I now purpose entering more minutely into details which, since my letter was written, have been developed and elaborated, while the cost of construction and annual maintenance has been more correctly ascertained. The system of intercepting sewers recommended by Hering & Gray, with, perhaps, the slight modifications referred to in Mr. Rust's report, will, of course, be a preliminary necessity, and somewhere upon the line of the high level one in the vicinity of the Eastern city limits, the purification works, which I now advise as most suitable, regarding economy in construction, simplicity, and low cost of annual maintenance, as compared with other methods, should be located. The flow of sewage upon leaving the high level sewer would first pass through a screening chamber, 10 by 20 feet, which would intercept foreign substances, thence the sewage would enter one or more of a series of eight receiving reservoirs, placed in a row, each reservoir being 34 by 40 feet, with graded floors some 18 or 20 feet lower than the sewer invert. These reservoirs would be fitted with metallic screens extending across the whole horizontal cross-section of each reservoir, to support coke strainers, the upper screen of all being intended to intercept all the solid faecal matter, and to prevent the latter from coming into contact with the coke strainers below. In this manner it is estimated that, with the present flow of sewage (16,000,000 gallons), about twenty tons of solid matter will be held back every 24 hours.

After passing through the coke strainers the fluid sewage, now purified to a very large extent, would be allowed to fall into the pump well, the bottom of which is designed to be 8 feet lower than the floors of the receiving reservoirs. This pump well would be about 285 feet in length, and 10 feet in width, with a capacity up to reservoir floor levels of about 140,000 gallons. Immediately adjoining the receiving reservoirs, and partially over the arched roof of the pump well, would be situated the pump and boiler house. The pumping plant would consist of a duplicate set of 24 inch centrifugal pumps. Each pump is calculated to discharge 25,000,000 gallons per 20 hours.

against a total head of 40 feet (which includes the suction lift). The pumps would be run by a pair of 400 h.p. compound engines.

There would be a battery of 10 horizontal tubular boilers; each boiler of 100 h.p. Eight of these boilers are intended to supply steam for the pumps, the other two for drying out the receiving reservoirs and the contents thereof, coke and sewage matter, preparatory to the latter being run into the boiler house as fuel to be used under the boilers. The sewage effluent, after passing through the receiving reservoirs, and having been rid of all suspended and solid matter, would be as well purified as any chemical process of precipitation can accomplish, and could be allowed to pass by gravitation from the pump into Lake Ontario without further treatment, at any depth desirable below the surface, where diffusion would at once take place. But, if still further purification were at any future period insisted upon, either by local boards of health, or Governmental authority, two alternatives are open for such a purpose, viz., either by intermittent land filtration for which very much less than half the area suggested by the city engineer at page 12 of his report, would suffice; or, by the construction of two sets of artificial filters of the following materials and dimensions: Half an acre of coke filters, 3 feet 6 inches in depth; six acres of sand filters, 2 feet 3 inches in depth, the cost of which would not, in all probability, exceed $28,000. The last mentioned artificial filtration areas are larger, proportionately, than the supplemental filters in use at Glasgow, Scotland, for a similar purpose. The first alternative would necessitate the purchase of about 200 acres of land, besides its preparation, also an extra pump, while the cost of the last would be limited to material and construction only, as the sewage effluent would gravitate from the pump discharge to the filter beds.

In immediate proximity to the boilers and receiving reservoirs, there would be a brick chimney 250 or 300 feet in height. The object of such a high chimney is, by a powerful draft and steam heat, to carry off the objectionable fumes arising during the process of drying out the contents of the reservoirs, for which purpose a system of steam coils connected with one or two of the spare boilers is designed. Also, besides ventilating the reservoirs, it performs another very important function during the flow of sewage by creating a tremendous draft from the fresh air inlets upwards, and thus oxygenating the sewage most thoroughly, as the latter falls from one strainer to the other. Each receiving reservoir is capable of passing, and partially purifying from 2,000,000 to 4,000,000 gallons of sewage daily, after which it would be shut off from the sewer, thoroughly drained, and then subjected to a drying temperature of 300° F., which, assisted by the draft of the tall chimney would desiccate in a few hours the coke strainers and several tons of faecal matter intercepted by the upper screen, sufficiently to be used as ordinary fuel under the boilers, to which means have been designed to run them with a minimum of labor.

Such is the brief description of a very simple and economical plant, by which Toronto's sewage problem can be solved; and I wish here to point out particularly that this scheme involves an innovation hitherto unknown, or at least unpractised, so far as I am aware, in any sewage plant anywhere, i.e., the total and profitable combustion of the solids. By this process there is no resulting sludge to press and get rid of at considerable expense, the fuel bill is lessened, while the solid matters disappear in vapor.

It may be interesting to state here that, in any extensive chemical precipitation process the disposal of the sewage sludge has always been found an enormous drawback, as each million gallons of sewage treated produces from six to eight tons of pressed sludge cake, which it has been found impossible to get rid of without extra expense. Were such a system brought into use here, it is no exaggeration to say that the city would find itself compelled to hire daily, either a train of cars, or a small fleet of barges to haul it away. Farmers might take a very small percentage of it, but the great bulk would have to be carried away at the expense of the city, and 16,000,000 gallons of sewage daily treated chemically, mean 128 tons daily of pressed sludge cake. With regard to the coke strainers experience has shown, beyond a doubt, that after drying out, that material is as useful for fuel as before; and I shall show presently how it decreases the fuel bill, after having served its purpose as a strainer in the receiving reservoirs. It should be mentioned that this plant is amply capable of handling 16,000,000 gallons of the dilute sewage of Toronto per day, and that the receiving reservoirs can be added to if necessary; also that each of the pumps will discharge 25,000,000 gallons per day of 20 hours, with ease. The daily consumption of coke for straining purposes would be about 25 tons, or 175 tons per week, and the daily cost of pumping 25,000,000 gallons against a head of 40 feet would be 12 short tons of anthracite coal. Reduced to dollars and cents the daily cost for coke, coal and wages, may be represented as follows:

Pumping, 12 tons coal, steam drying, 3 tons coal; 15 tons coal, say at $3.75		$56 25
Deduct 25 tons coke recovered from reservoirs, valued at one-fourth its weight of coal=6.25 tons at $3.75	$23 43	
20 tons desiccated faecal matter, equivalent to 4 tons combustible matter, but not taken into account		23 43
		$32.82

The daily cost for labor would be:

Wages of two engineers at $2.50	$5 00	
Wages of four firemen at $1.75	7 00	
Wages of twelve laborers at $1.75	21 00	33 00
		$65 82
Add 25 tons coke required daily for strainers (high figure) at $4		$100 00
Total daily cost of maintenance		$165 82

Or $60,524.30 per annum

ESTIMATED TOTAL COST OF DISPOSAL WORKS.

Excavation		$30,000
Brickwork		30,000
Concrete		4,200
Iron work		6,000
Drying apparatus, coils, piping, etc		10,000
Ducts, or flues from receiving reservoirs to chimney		3,000
Flues from boilers to chimney		3,000
Roofing and carpenter's work		4,000
Bricking in boilers (10)		3,000
One centrifugal (24-inch) pump, one pair of 400 h.p. compound engines, 4 horizontal tubular boilers, aggregating 400 h.p.; feed pump, piping to connect boilers and engines, engines and pump set up on foundation, boilers placed ready to be bricked in	$15 000	
In duplicate		30,000
Two additional boilers (steam drying)		2,000
Additional: suction and discharge piping, etc		1,000
Brick chimney (300 feet in height)		45,000
Coal and coke sheds		10,000
Eight branches connecting sewer with the different screening chambers, fitted with gates, and sundry other items		10,000
		$191,200

Note.—I am indebted to the Northey Mnfg. Co., Ltd., for the estimates as to the pumping apparatus and boilers.

It is important to explain here that the use of coke strainers has not been advocated without good reason. At Lawrence, Mass., U.S.A., experiments by the State Board upon the best known methods of sewage disposal have been tried during the last decade, and the results of the last two or three years, with regard to coke strainers, have shown that a 6-inch layer of that material has purified city sewage at the rate of 1,000,000 gallons per acre daily, and removed 62 per cent. of the organic matters (albuminoid ammonia), and 50 per cent. of that determined as "oxygen consumed," also that, at the rate of 4,000,000 gallons per acre daily, 38 per cent. of the total organic matter has been eliminated. The report of 1896 states emphatically besides, that coke straining removes organic matter as thoroughly from sewage as it is possible to do with any chemical or sedimentation process whatsoever, besides having the advantage of getting rid of the concentrated sludge liquor. It must also be remembered that, in the method which I have now advised, I have gone a step forward, by the retention of the solid faecal matter above, and entirely out of contact with, the coke strainers, thus relieving the latter of a very large percentage of organic matter to be dealt with. Obviously this is equivalent to increasing proportionately the area of the straining surface. The total combustion of the solids under the boilers, and the riddance of the expensive and intolerable sludge nuisance, are also advantages which must weigh with, and appeal to, even the least thoughtful of municipal economists.

It has been said that intolerable smells would arise from this combustion process. Not so. The high chimney will cause any bad odors to be carried away and dissipated in the atmosphere, far above the highest part of the city or neighborhood.

I may instance the Townsend and St. Rollox chemical works chimneys at Glasgow, Scotland, besides others in England, Germany, and in the United States, situated in the midst of dense populations, which carry off immense volumes of most deleterious gases, without inconveniencing the people below; but a little consideration will satisfy the most sceptical that nothing need be feared upon that score.

Mr. Rust estimates the cost of 600 acres of land, and the preparation of 300 acres for intermittent filtration, at $240,000. This, of course, presupposes the land to effect the purification of the crude sewage as it comes from the sewers.

My estimate for a filtering area of suitable natural soil, such as is said to be available to the northeast of the city, would be a tract of only 200 acres, which is amply sufficient to effect the final purification of the partially purified effluent from the coke strainers, being at the rate of 160,000 gallons per acre daily, for 16,000,000 gallons of a daily output. Such an area, upon the basis of Mr. Rust's estimate, would certainly cost less than $80,000. In the event, therefore, of a pressing public demand for complete purification, by final filtration through natural soil, entire and thorough treatment would cost, by the method I have outlined, as follows:

Coke straining and combustion works, pumping station etc	$191,200
Land for above (Mr. Rust's estimate)	10,000
Extra pumps, boilers, etc., required for pumping to land northeast of the city	20,000
Force main (Mr. Rust's estimate)	115,000
Two hundred acres of land for filtration purposes, and preparation, being taken at exactly the third of Mr. Rust's estimate. This is manifestly too high	80,000
.. ..	$416,200

Which is only 57-100ths of the city engineer's estimate for the cost of intermittent filtration and 75-100ths of that of his chemical precipitation scheme, *which has still the sludge to deal with.* The three proposed processes now stand thus, as regards cost of construction:

Coke straining and combustion process, followed by intermittent filtration	$416,200
City engineer's estimate for intermittent filtration	730,000
City engineer's estimate for chemical precipitation	555,000

And, as regards cost of maintenance per annum:

Coke straining and final purification by intermittent filtration	$65,000
City engineer's estimate for intermittent filtration	70,000
City engineer's estimate for chemical precipitation	105,000

In conclusion, I may remark that the coke straining may be carried to any extent by more frequent changes of coke than I have allowed for, it is simply a question of more coke and less coal, but the quantity estimated (175 tons weekly), will purify quite sufficiently for all practical purposes, especially if followed by intermittent filtration.

RETAINING WALLS.

Editor CANADIAN ENGINEER :

In a communication, published in your journal a year or two ago, I commented on the failure of the Bouzy dam in France, when some 230 persons perished in the flood; I then advocated a thickness of dam equal to the height or depth of the impounded fluid. That and other failures of retaining walls of masonry seem to have brought about a general concensus of opinion among engineers that this is safe practice; and in fact, retaining walls of all kinds, now-a-days, are built in a way more or less in accordance with this view.

Dams of masonry up to the present era used to be made of a thickness hardly greater than one-half the height or depth of water to be held back. This was done under the assumption that the weight of masonry being at least, or even more than, double the weight of water. Such a thickness of wall would suffice to retain it in situ. So it would, if the masonry could continue for all time to remain an homogeneous mass, thoroughly bound together by its cementing mortar. But it is well known now that this cannot or at least does not continue to be the case indefinitely. Whether through time and infiltration or other causes, the cementing medium deteriorates and rots away to sand in the course of years, when the superincumbent layers of masonry become, so to say, dislocated and detached and capable under sufficient pressure of sliding or moving the one upon the other. The friction of masonry on masonry or of one course of stone-work on another may be taken at a resistance, so to say, of 50 per cent. of the weight or vertical pressure; and, as in the case of a stone disintegrated dam of which the thickness is only half that due to the pressure weight on depth of water at any point, the resistance is therefore only equal to or less than that pressure, and the dam must in the course of time give way.

Hence, I advocated, as said before, a thickness equal to the depth of water, as in that case the loose material itself without the binding of it together by mortar, would still be of a weight more than double that of water, and such that its 50 per cent. of frictional resistance would be in excess of the pressure brought to bear against it. I am led to these remarks by an illustrated article in the last issue of The Scientific American, descriptive of a dam now in the course of erection at a point some five miles west of Mateo, a suburb of San Francisco in California.

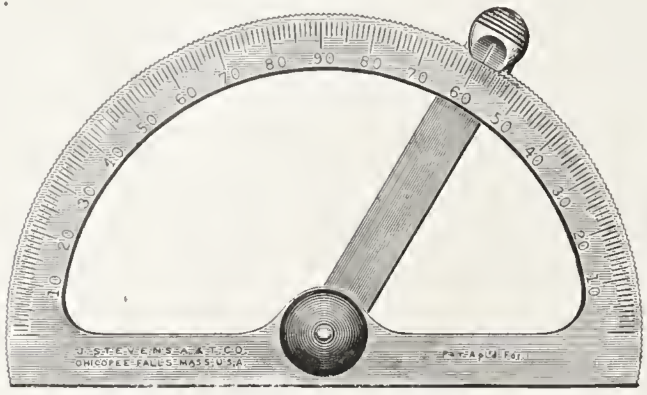
This dam is built of concrete, and is the largest of its kind in the world. Concrete dams were heretofore on the monolithic plan, or as if a solid homogeneous mass of material. Concrete, however, as may be seen, even in floors and sidewalks, is contractile and separates into parts, leaving fissures between them, and thus destructive of the impermeability of a water retaining structure. Hence they are now-a-days built in blocks, and given time to dry and contract before they are cemented together. This is the mode Herman Schussler, C.E., has adopted of doing his work. The component concrete blocks of some 30x40 feet in horizontal area being built in boxes or bottomless caissons, as it were, with movable sides, and made to interlock or dove-tail, the one into the other, thus breaking joint, as the saying is. These blocks are made of the uniform height of eight feet, and every layer thereof left to dry thoroughly and shrink before another layer of similar blocks is laid over it.

The dam alluded to bears out my views, and those of the profession at large, in that its thickness is equal to the height or depth of water to be held up. Its length is, or will be, when finished, not less than 832 feet on top, or at the crest. Its present height is 145 feet and breadth of base 176 feet, or equal to its finished height which, as it has to rise still by 30 feet, will be 175 feet. The thickness at the present height is 40 feet, or some five feet in excess of the depth of water above this point. The dam is curved or convex up stream to a radius of 637 feet, or versed sine, of over 100 feet, and its strength and resistance thus added to materially. The quantity of water impounded will be 19,000,000,000 (nineteen thousand million gallons). The down face slope or batter of the dam is one horizontal to four vertical. The up face slope is one to one, to within 60 feet of its full height, whence it is, like the outer slope, one to four, and the two slopes joined by a curve of a radius of 300 feet. The foundations were excavated down below the original surface to a depth of from 8 to 35 feet, until solid rock was reached, and to guard against fissures in even this, a trench was further sunk to a depth of 17 feet with a width of 5 feet at bottom and 10 feet at top, and this filled with concrete solidly rammed down with heavy iron rammers. This trench runs the whole length of the dam, following of course its curvature and reaching to its extremities at opposite sides of the valley. May we hope, sir, that these prudential measures will always obtain in the future, and that we have heard the last of the appalling catastrophies due to failures of such structures.

CHAS. BAILLAIRGE, C.E.

Quebec, December 19, 1898.

ANGLE INDICATOR.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(FAY'S PATENT).

This tool is what its name implies. It is to be used in connection with a universal bevel for transferring any given angles. It will produce a given degree as accurately as any micrometer protractor, but not the minutes. It is nicely graduated from 0 to 90 deg., reading from both ends, and it is finished in the Stevens Arms & Tool Co.'s usual superior manner. We cannot emphasize too strongly its great usefulness. It is stated that it should be in the hands of every machinist, tool-maker, draughtsman and metal sheet worker, in fact, any person who desires a handy angle indicator.

CONCRETE RAILWAY STRUCTURES.*

BY F. G. JONAH, M. CAN. SOC., C.E.

That concrete possesses many great advantages in the construction of railway structures is being more generally appreciated from year to year, and with the increasing interest in this class of work the writer feels warranted in presenting to the members of this society some designs of concrete culverts and bridge piers. These structures are particularly well adapted for use in the construction of new lines of railway, owing to the comparative ease with which the material for making concrete can be transported, as against heavy stone-work. The use of derricks for loading and unloading material and specially constructed wagons for heavy hauling are not necessary in concrete work, and, as it can be made with cheap, unskilled labor, a great saving in the wages of the force employed is thus effected. These culverts have a decided advantage over cast iron pipes on new works, owing to the great cost of transporting the pipe, but for renewals on old roads, cast iron pipe, up to five feet in diameter, is excellent. They will be much safer from washouts, however, if the ends are protected by wings, for which nothing is better than the concrete ends shown on the culvert plans. The plans submitted ranged in size from an 8 inch sewer pipe, with concrete ends, up to a five foot arch culvert. In 1894 the writer built upwards of thirty culverts after these plans, and up to the present time there has not been a failure of any kind about them.

The arches were turned with hard brick; in a larger culvert they could be made entirely of concrete, but for a small semicircular arch there would be difficulty in holding the fresh concrete in place. In the construction of these culverts, wooden forms are necessary for the work above the bottom or pavement line. The forms are practically moulds into which the concrete is dumped. They should be made of lumber not less than 1½ inch thick, dressed on the side next to the concrete. They should be well made and held together with clamps, to facilitate putting up and taking apart rapidly. If carefully used, one set of forms will serve for a great many culverts. For that portion of the culvert which is in the ground, including the back of side walls, the earth should be carefully excavated to the exact form of the culvert, any irregularities or holes beyond the figured dimensions will represent a waste of concrete. In putting the concrete in place, great care must be exercised in tamping it thoroughly, to insure a close contact with the forms. If this is not done, the work will present a honeycomb appearance when the forms are removed. Forms should be left standing in place until the concrete has partially set. It was found in this work that to make one cubic yard of concrete required 1.17 barrels Portland cement, 24.5 cubic feet of broken stone and 9.3 cubic feet of sand. To make a cubic yard of brickwork required 400 ordinary size brick and .93 barrels natural cement. The material was hauled an average distance of three miles, and cost on cars as follows:

Portland cement, per bbl	$2 90
Louisville cement, per bbl	90
Machine crushed macadam, per cubic yard	2 10
Sand per cubic yard	80
Brick, per M	8 00

The following rate of wages was paid:	Per day.
Teamster, man and team	$2 50
Bricklayers	2 50
Concrete gang:	
Foreman	2 00
One laborer	1 50
Six laborers at	1 25

The average cost on all culverts was:

Earth excavation in foundations	$ 35
Concrete per cubic yard	6 80
Brick-work per cubic yard	7 70

TORONTO WATER WORKS CONDUIT.

The first or north section is that across the harbor from the pumping station to Hanlan's crib. It consists of two pipes nearly parallel, the westerly pipe 3 feet in diameter, of cast iron, with each joint flexible, laid in 1874; the easterly pipe of steel, 4 feet in diameter, laid in 1889 and 1890; the length of this section is 4,660 feet. The second or central section is that through Blockhouse Bay and across the Island from Hanlan's crib to the shore crib. It consists of two parallel pipes, the southwesterly one of wood, 4 feet in diameter, laid in 1873, 1874, 1875 and 1876, but abandoned on the completion of the second pipe, which was laid in 1889 and 1890. The northwesterly and new conduit is of steel, 5 feet in diameter. The length of this section is 6,027 feet. The third or south section is that in Lake Ontario, from the shore crib to the intake. A wooden pipe 6 feet in diameter for a distance of 2,357 feet, laid in 1881 and 1882. This section was extended a distance of 365 feet in 1890 and 1891. This extension is of steel 6 feet in diameter, making the total length of this section 2,722 feet. The manholes are of iron, with a trap-door at the top of each, not air tight.

(For profile of conduit see City Engineer's Report, 1893, pp. 3 and 4. This shows the depths to top of conduit, the filling over it, the points where pipe broke, etc.).

In the latter part of 1893, after the conduit had been fully repaired, the friction head was measured and found as follows: "While by D'Arcy's formula the head consumed on the 6-foot pipe was sufficient to deliver 32,000,000, on the 5-foot pipe 28,000,000, and on the 4 and 3 foot pipes, 29,000,000 per 24 hours, or expressing it in friction head, the total measured head was 6.5 feet to deliver 22,500,000, against a calculated head of 3.91 feet, showing a loss of 2.59 feet, the water in the lake being 1 foot 9 inches above zero." (See pp. 31 and 32 City Engineer's Report, 1893). The actual head in each section is given in this Report, but it is evident that the 6-foot section was not carrying the water it should. In examining it since the last accident, sand was found in it to a depth of 2 feet in places. Making an approximate calculation for the obstruction in the 6-foot pipe, and taking a higher coefficient for roughness the theoretical head in each section necessary to deliver 22,500,000 of gallons per 24 hours would be as follows:

	Head.
North Section—4 foot and 3 foot pipes combined, 4,660 feet long	3.00 feet.
Central Section—5 feet diameter, 6,027 feet long	2.65 feet.
South Section—6 feet diameter, 2,722½ feet long	0.85 feet.
Actual head	6.50 feet.

With the lake 18 inches below zero it will be found that the hydraulic grade line when delivering 22,500,000 gallons at pump well, will touch the top of the 4-foot conduit at one point only, that is, 125 feet north of Hanlan's crib, at which point the conduit rose in 1892, and again in 1895. On the profile of 1893 it is shown as uncovered with sand. In the second section the top of conduit is above the hydraulic grade line for nearly half its length, at one point being half the diameter of the pipe above it. At this point the conduit rose in 1892, also at the second highest point in this section.

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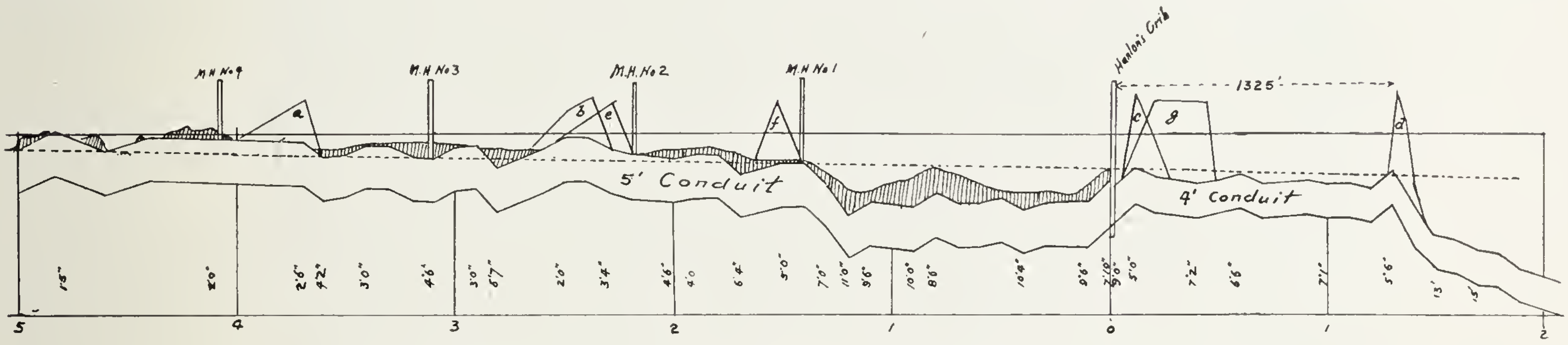
*From a paper read before the Canadian Society of Civil Engineers.

To test the filtering capacity of the basin on the Island, pumping through the 4-foot wooden conduit was commenced on November 25, 1875, and continued until December 7, 1875, when portions of this pipe came to the surface. This rising was doubtless due to lack of sufficient covering above the pipe. The contractors when the accident occurred claimed that it had been covered as specified, and attempted to prove that the specified covering was insufficient. The elevation of the lake was about 5 inches below harbor zero when the rising occurred. The contractors, however, paid the cost of re-laying and recovering the portions that rose. This pipe was abandoned in 1890 on the completion of the parallel steel conduit, 5 feet in diameter.

On December 25th, 1892, the steel pipes suddenly rose at two points in the first section, near Hanlan's crib, and at two points in the second section. At this time the lake elevation was about 18 inches below harbor zero.

(For description, see City Engineer's Report, 1893, pp. 5, 6 and 35 to 53; also W.W. Superintendent's Report, 1892, p. 9; for capacity of conduits, see City Engineer's Report, 1893, pp. 31 and 32).



PROFILE SHOWING PART OF THE TORONTO WATERWORKS CONDUIT, MARCH, 1893.

The pipe rose at points "a," "b," "c" and "d," in 1892, and at points "e," "f" and "g," in 1895. The upper horizontal line is 18 inches below "zero level" of the lake, and the dotted line is the approximate hydraulic grade line. The vertical numbers give the depth to the top of pipe below "zero level" of the lake, and the shading slum the covering of sand over the conduit.

On the morning of September 5th, 1895, the conduit rose in the first section at the same point as one of the breaks in 1892, also at two points in the second section. The lake at this time stood at 9 inches below zero. (For description, see City Engineer's Report, 1895, p. 68).

From 1888 to 1893 there was no experienced civil or hydraulic engineer at the head of the waterworks department of the city of Toronto. During this period the city spent about $200,000 on these conduits, which were designed and constructed under the department staff. After the rising of the conduit in December, 1892, the waterworks department was re-constructed, and on January 30th, 1893, the works were placed under the direct supervision of the city engineer.

The large amount paid for engineering and engineering advice in 1895 was simply the arrearage due the engineering profession.

The accident to the wooden conduit of 1875 was doubtless caused by an insufficiency of filling over it. The contractors had notified the city engineer that this work was completed, but the engineer had not satisfied himself of the correctness of their statement. The contractors endeavored to prove that the covering specified was not sufficient, and claimed upon engineering advice, that if the water were drawn down to a depth of seven inches below the top of the pipe the upward pressure of air on inner surface exposed would more than equal the weight of 2½ feet of sand above it. After the pipe was re-laid and the re-filling completed, the water was drawn down much more than the seven inches, but the pipe did not rise. The contractors then acknowledged that their expert's demonstration was incorrect, and that the uprising was due to insufficient filling. The uprising of Christmas Day, 1892, was a surprise to everyone. In the report of the waterworks superintendent for 1892, p. 9, will be found a very brief statement as to the cause of this rising. A quantity of weeds was found at a screen that had been temporarily placed in the shore crib, where the 6-foot wooden conduit connected with the 5-foot steel pipe. The examination and tests then made to determine the cause were of a very superficial character, and it is now more than doubtful if the official reasons were the correct ones. It was apparently regarded as an "accident," caused directly by the pump-house engineer not following his instructions to stop the machinery if the pump well lowered beyond a certain point. A float in the well could have been connected with a throttle valve, thus automatically stopping the engines. The pipe rose, however, and it cost $50,000 in money, and three months' time to repair it. If the cause of the rising were fully understood why were not automatic registers placed in the different manholes along the conduit, and at the pump well, to record the fluctuations in friction head? Why was the conduit not covered with sand at all points that were above the hydraulic grade line, loaded with stone filled cribs, or anchored down with piles? Why, if the department knew the danger of an accident occurring, were not daily inspections made of the conduit after it was repaired in 1893? One inspector could have examined the conduit daily at each manhole along its course, noted the velocity, the elevation of the water, and could have thus detected any evidence of foul play or symptoms of an accident?

Official reports were made to the city council warning that body of the danger in not having a more perfect conduit, yet no steps were taken to lower the high points to grade, to load it, or to even guard it by patrolling. It was claimed that it was leaky, that large quantities of sand had found entrance to it, and that it was in danger of being broken at any time by vessels. The experiment made in 1894 (see report for that year, p. 99), demonstrated that the conduit across the harbor was practically water tight. Neither bay water or sand could therefore enter this section. In the second section the surrounding water is much better in quality than in the harbor, and the pipe is partially bedded, and in places covered with sand. The official reports withhold all information respecting the actual leakage into this section. The leakage in the lake section would be trifling owing to the low head, and the water entering it would be of comparatively good quality. Until proven to the contrary it may be claimed that the conduit in 1894 and in 1895 to September 5th was not leaking, and that no sand was entering it.

In repairing the breaks in 1893 and in 1895 large quantities of sand were found in the conduits in the vicinity of the breaks, but there is no reason for assuming that this sand was there before the pipes rose, but every reason for believing that it entered at the time of the upheaval. The danger from the vessels was slight, and could have been practically eliminated by proper buoying and marking of the line of conduit. The rising of the conduit on September 5th, 1895, in exactly the same way as on December 25th, 1892, was doubtless a shock to the waterworks department. The following is the alleged combination of circumstances that caused the "accident." (City Engineer's Report, 1895, p. 69):

First.—Enormous accumulations of sand in the conduit.

Second.—The unprecedented low state of the water in Lake Ontario.

Third.—By a vertical plank obstruction found in the lake shore manhole.

Suggestions of foul play were circulated at the time of the accident, but they do not appear in the official report. An explosion of dynamite would have caused effects that could not have been overlooked. This charge against unknown malicious parties was soon dropped, but the search for the point where the dynamite was applied disclosed the fact to the public that the conduit had not been properly or regularly inspected.

A piece of planking about 16 inches wide, 3 inches thick and 8½ feet long was found in a vertical position in a manhole near the lake, in the 6-foot conduit, the lower end being imbedded in sand. The newspapers at the time reported that the engineers had stated that this was doubtless the cause of the accident, but it was then assumed that the reporters had manufactured the item, in their sanguine efforts to fathom the mystery. We find the statement repeated on page 69 of the City Engineer's Report for 1895. The capacity of the 6-foot conduit is there stated as being reduced 40 per cent. by the plank and the sand. The depth of sand is not given in the text, but the newspaper at the time gave it as 18 inches at this point, which agrees with the depth shown on the profile of the conduit given in the Engineer's Report. How much of this 40 per cent. was due to the sand and how much to the plank ?

The sand accumulations would be gradual, and examinations after the uprisings showed that they were chiefly in the 6-foot conduit, and in the vicinity of the broken joints. The average depth of sand in the 6-foot conduit was probably 18 inches. (See page 88, City Engineer's Report, 1895, also profile, page 68). At the time of the rising the water stood at 13½ inches below zero, and a few inches higher than in December, 1892. A glance at the chart of the lake elevations during the preceding forty years would have shown that the elevation in September, 1895, was not "unprecedented," as it had been lower than this in no less than four different years. The lower the water the lower the hydraulic grade line, and therefore the greater the risk of rising. Gaugings of the lake are taken several times per day, and the engineer at the pump-house keeps a record of the level of the water in the pump-well. It cannot be claimed, therefore, that the department was not aware of the low stage of the water, yet the conduit was not kept from rising. It had been reported against and condemned, yet little had been done towards making it safe as the lake lowered. If, therefore, low water were the cause, it could not have been fully appreciated by the department.

It is a well-known fact that all surface waters contain small particles of air, without which it is claimed fish would die, and possibly all subaqueous animal life cease to exist. In laying conduit pipes on land engineers place at all apices, air valves to permit the escape of air that collects at such points. These valves may be automatic. Small pipes carried from each apex to a point above the hydraulic grade line serve the same purpose. Referring to the profile of the conduit immediately north of Hanlan's crib there are two points or apices that touch or pass the hydraulic grade line. It is evident that air would gradually accumulate at these points. The conduit has risen twice at one of these points and once at the other. If it be granted that air accumulated so as to fill more than one-third of the volume of the pipe at one point, then it is easy to show that the pipe would rise. The 4-foot conduit was laid in lengths of 57 feet, of Scotch steel plates, ⅜-inches thick, each length weighing about 12,000 lbs. (See Report, 1890, p. 18). This gives a weight per lineal foot of pipe of 210 lbs. The water contained in one lineal foot of this pipe weighs 785 lbs. If, therefore, one-third of this water becomes replaced with air the pipe must rise, unless loaded. The 5-foot pipe weighs 300 lbs. per lineal foot, and the contained water 1,230 lbs. In this case a removal of one-fourth of the water would jeopardize the pipes' stability. Every engineer who has had experience in testing waterworks distribution systems, pumping engines and long conduits, knows that the theoretical pressures are frequently increased enormously by what appear to be comparatively small changes in conditions, caused by the inertia of the moving mass of water. If there be air in the pipes, these fluctuations will be aggravated.

Now, is not this what occurred at each of the two risings of the steel conduit: First, the conduit was above the hydraulic grade line at some points, and close to it for a great distance. Second, air had accumulated at many apices. Third, fluctuations in the head caused variations of pressure on the air pockets. Fourth, a bubble of air escaped from one or more of the high points, ran to a higher point, and caused a disturbance in the water, a surging backward and forward. Fifth, this surging of the water produced alternate compression and expansion of the air, at one of which expansions the pipe rose, the water hammer contributing to loosen the pipe from its bed. Sixth, by rising at one point a violent commotion was instantly set up at other points where air had accumulated, and the conduit rose at several such points.

If there were a leaky point at an apex it is possible that the air might have escaped. This in reply to the query: "Why did not pipes rise at all high points ?" In 1893 the conduit was replaced and repaired, but the cause of the rising was certainly not understood, or if so not made public. By carrying small pipes from the principal apices to a few feet above high water level, the air can be removed and the full capacity of the pipe utilized, to the hydraulic grade. The sand deposited over the conduit would tend to improve the character of any water that might leak into it. It was officially announced in 1892 and 1893, that the first uprising was caused by the clogging of a screen at the shore crib with weeds. This was generally believed at the time, but since the second accident when nothing of the kind was discovered, the thinking public became skeptical as to the correctness of the reason given in 1892-3. The conduit was in continuous use nineteen months before the accident of 25th December 1892, and about thirty months after the repairs following this rise. The greater length of the second period may be accounted for by the higher lake level in 1893, the strengthening of the weakest high points, and the gradual silting up of the channel in which the conduit was laid. Loading the pipe by sand, by cribs, or by driving piles and bolting cross-timbers above the pipe, will prevent an uprising, but cannot prevent the accumulation of air, and a reduction in the capacity of the conduit.

BOATS OF THE DOMINION TYPE

Editor Canadian Engineer :

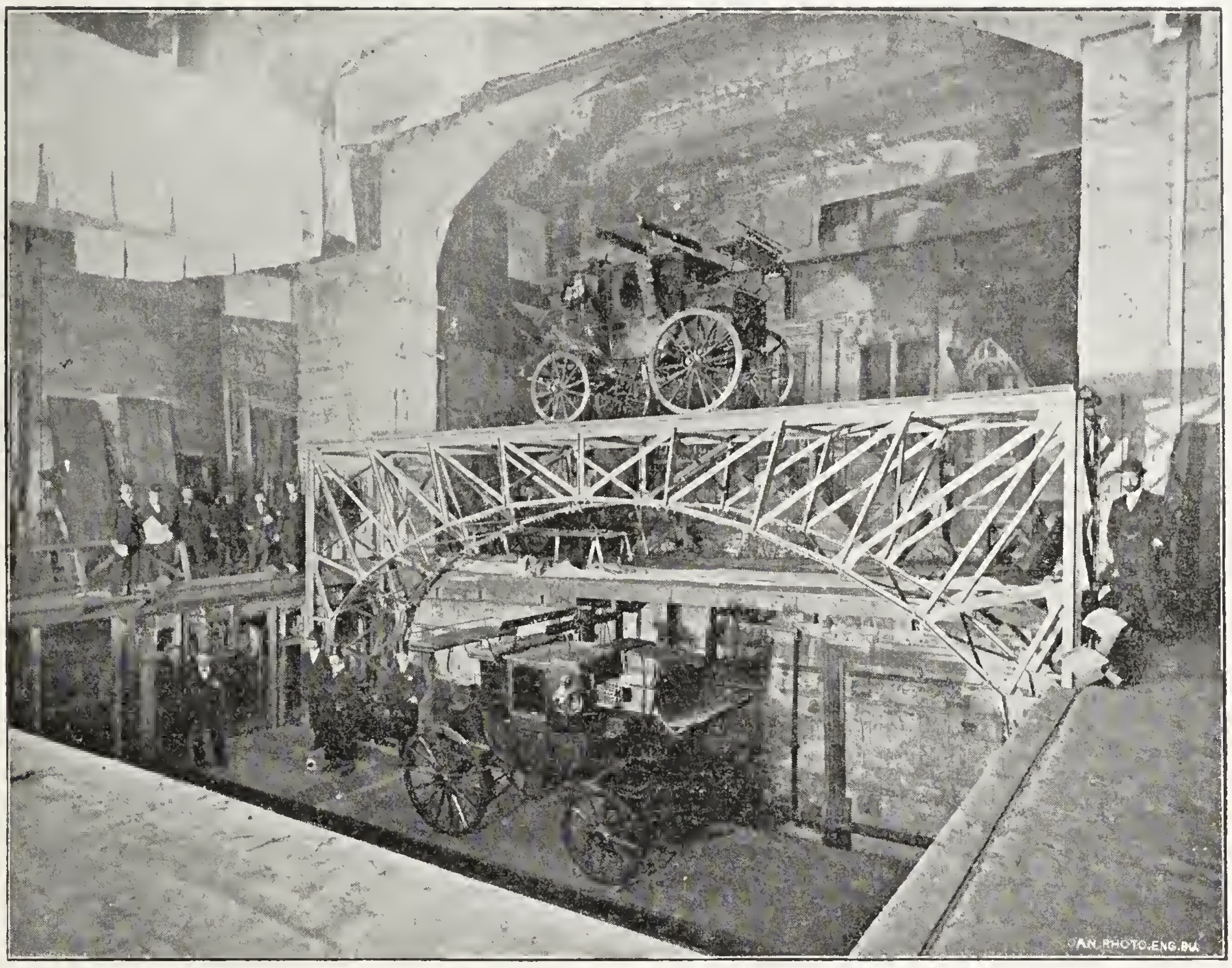
It is remarkable how often minds in diverse positions will run in nearly parallel lines on some subject. Your November article upon the latest defender of the Seawanhaka Cup recalls an idea I developed in 1894 for what I termed "hollow-keeled boats," consisting of a fine lined shell, barely enough to float the crew, while over it was superimposed a wide shallow hull, with easy lines, of which the former would represent a hollow-keel. Say a boat 15 feet long, 4 feet wide, 10 inches deep, with a shell keel 12 feet long, 12 inches beam, and 4 to 5 inches deep, will float one man with feet in the run aft, seat on the floor of the larger boat, and centre of gravity lowered the amount of depth of keel. This gives extra depth for stepping mast, centreboard, rudder, etc., while leaving a very light buoyant skiff on the top of the water. If the keel be made detachable, one skiff may have a flat keel for duck hunting and shallow streams; another for rowing and paddling of light draft; while for sailing, a sharp, deep, heavy keel and centreboard will be most satisfactory, giving virtually three boats in one. I built one eight feet long, which runs very well for its size; and I intend trying one with detachable keels, when time permits. I have tried double keels, but find that in a head sea they are apt to fill between hulls and deaden headway. For small motors the hollow keel gives deeper immersion of the propeller, and lower centre of gravity, than in the canoe model of craft. Probably some of your nautical readers may improve upon the above suggestions.

Thomas Frood.

ELECTRICAL STAGE APPLIANCES.

(Correspondence Canadian Engineer).

The proposed application of electrical power for mounting plays in the Drury Lane theatre, London, on the lines advocated by Edwin O. Sachs, architect, has taken a tangible form in the completion of the first section of the stage installation in time for the season's pantomime. Mr. Sachs' present work refers principally to the stage floor, and its movability in sections above and below the footlights. The total area now already movable by mechanical power exceeds 1,200 square feet. The electrical appliances just completed take the form of so-called "bridges," each working independently. Each individual section measures 40 feet by 7 feet, and weighs about six tons, of which about four tons are counterbalanced. They can travel about 20 feet vertically. The motive power is from the ordinary electric supply mains over a four-pole motor, developing 7½ h.p. at 520 revolutions per minute. The "bridges" are suspended from cables, and these, working over the motor allow the former to be raised with the necessary live load at rates varying from 6 feet to 20 feet per minute. Every possible safeguard is provided against accident, the "bridges" themselves being so constructed that in the event of derangement of current the appliances can be worked by hand gear. Automatic switches are provided so as not to be entirely dependent on the attendants, and automatic catches will work in case of rope breaking. Special locking gear has been installed to hold the "bridges" stationary at certain points, such as stage level, and a very large factor of safety has been allowed in apportioning the strengths and weights in the various parts of the mechanism, having special regard to the ever-increasing scenic requirements. As regards the economic aspect of the electrical installation the initial outlay on Mr. Sachs' system is about half that of continental hydraulic work, and this is allowing for English contractors as against foreigners. The maintenance is minimal, whilst the actual working only costs a few pence per performance. The saving in manual labor on the stage is very considerable, whilst the hygiene of the theatre is materially raised by the absence of woodwork. For the successful execution of this work Mr. Sachs is primarily indebted to the enthusiastic encouragement of Arthur Collins, who is the first manager to introduce modern methods on the stage, and deserves the congratulations of the technical professions. He has been ably seconded by the Thames Iron Works, their engineers, Messrs. Stewart & Grove, having to meet innumerable difficulties, as most of the work was carried on at odd moments or at night during the run of the "Great Ruby."



THE STAGE, DRURY LANE THEATRE, LONDON—ELECTRICALLY OPERATED.

THE STEAM BOILER AND ITS SAFETY.*

The modern demand for high-pressure engines is fostering sectional and water-tube boilers. The more rapid adoption of such boilers is retarded on account of so many of their parts being made of cast iron, together with so many joints and connections. These are objected to by the old-type manufacturers, and those unwilling to accept something new. Nevertheless the external horizontal tubular boiler will soon be out of the modern class as a steam generator. It is limited in the thickness of sheet, therefore, in its diameter. Consequently on account of its being externally fired, its pressure and power is limited. This alone has turned the attention of boiler manufacturers to a more perfect arrangement for stationary, as well as marine purposes.

At the present day, the choice is for high pressure in stationary boilers, embracing several designs of water tube and internally fired boilers of different type. From an economical standpoint there is little difference, notwithstanding the claims and reports of efficiency tests advanced by the makers of the different designs. On the other hand the safe working pressure of the boiler, we are compelled to take the maker's figures as there is no law in this province formulating the proper rules, founded on mechanical principles, to determine the safe working pressure of the steam boiler. An instance of the above occurred to me quite recently when called upon to inspect a horizontal, tubular, externally fired boiler. The dimensions of the boiler were 72 inches diameter and 16 feet long. The plates of steel ⅜-inch thick with a tensile strength of 60,000 lbs. per square inch. There were 114 3-inch tubes, and the heads were of flange steel ½-inch thick. The longitudinal joints were double riveted; the rivets being ¾-inch in diameter, and the pitch 3 inches, and it is fair to suppose the holes at 13-16 inches. The efficiency of the joint so far as net sections of plate is concerned is 3-in.—8125÷3 in.=72.9%. The area of a 13-16-inch hole being 0.5185 square inches, the single shearing strength of one rivet is .5185x38,000=19,700 lbs., and as there are two rivets in a unit section of the joint (the joint being double riveted), the total shearing strength of the rivets in a unit section is 39,400 pounds. The strength of a strip of the solid plate, 3 in. wide, being 3x⅜x60,000 lbs., equal to 67,500 lbs. Then for the efficiency of the joint so far as rivet area is concerned is 39,400 divided by 67,500=58.4%. This is much less than the efficiency of the net section, therefore it follows that the joint is badly proportioned. The rivet area is too small; notwithstanding this the builders had no hesitation in recommending this boiler for a safe working pressure of 100 lbs. per square inch. Whereas with a factor of safety of 5 the safe working pressure on it is 73 lbs. per square inch. The safety valve was set at 100 lbs. per square inch, and the owners of this boiler congratulated themselves on their new steel boiler. Really the boiler was no stronger with the 60 000 lbs. steel than it would have been with 50,000 iron. Now a proper double riveted lap joint for this boiler would be diameter of rivet ⅞-inch, pitch 3 7-16-inch. Efficiency of joint 69.4%. This would give a safe working pressure (with a factor of 5) of 87 lbs. per square inch. Many years ago Sir William Fairbairn stated the efficiency of a single riveted joint to be 56 per cent., and that of a double riveted joint to be 70 per cent. No doubt he meant it to be understood that this was the limit practically obtainable with careful design and construction, and I am sorry to say that it is a common practice among engineers who should know better, to allow 56 and 70 per cent for single and double riveted joints respectively, without the least regard to the actual proportions of the joint.

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*A paper read before Hamilton Branch, C. A. S. E. by F. G. Mitchell, London

Another case which came under my observation not long ago, was a horizontal tubular boiler, externally fired, 48 inches diameter and 12 feet long, the plates were of steel 60,000 lbs. tensile strength, 5-16 inches thick and single riveted. The diameter of the rivets was ⅝ inches and the pitch 1¾ inches, the heads ⅜ inches thick. The workmanship of this boiler was excellent in every respect, and I believe the material was also. The only objectionable point about the boiler was the riveted joint. The diameter of the rivets being ⅝-inch we will suppose the holes to be 11-16-inch or 0.6875. The pitch being 1.75, the efficiency of the joint so far as the net section of the plate is concerned is $\frac{1.75\text{-inch}-0.6875}{1.75}=60.7\%$. The area of a 11-16-inch hole being 0.3712 square inches, the strength of one rivet (assuming the shearing strength of rivet iron were to be 38,000 lbs. per square inch), is $.3712 \times 38{,}000 = 14{,}100$ lbs., and the strength of a strip of the solid plate 1.75 inches wide, being 1.75x5-16 inches x 60,000=32,800 lbs. We find that the efficiency of the joint so far as rivet section is concerned is 14,000 divided by 32,800=43%, whereas if properly designed it should be 56%. Now, why is it that an otherwise good boiler manufacturer will allow construction such as this? He might as easily and without any more expense, have turned out a much better and safer boiler. It may be possible that the templets used had been arranged for 40,000 or 45,000 lbs. per square inch iron. This does not explain the whole thing, for now-a-days the manufacturer will go even a step closer by using only a factor of 4 with practically the same externally fired boiler.

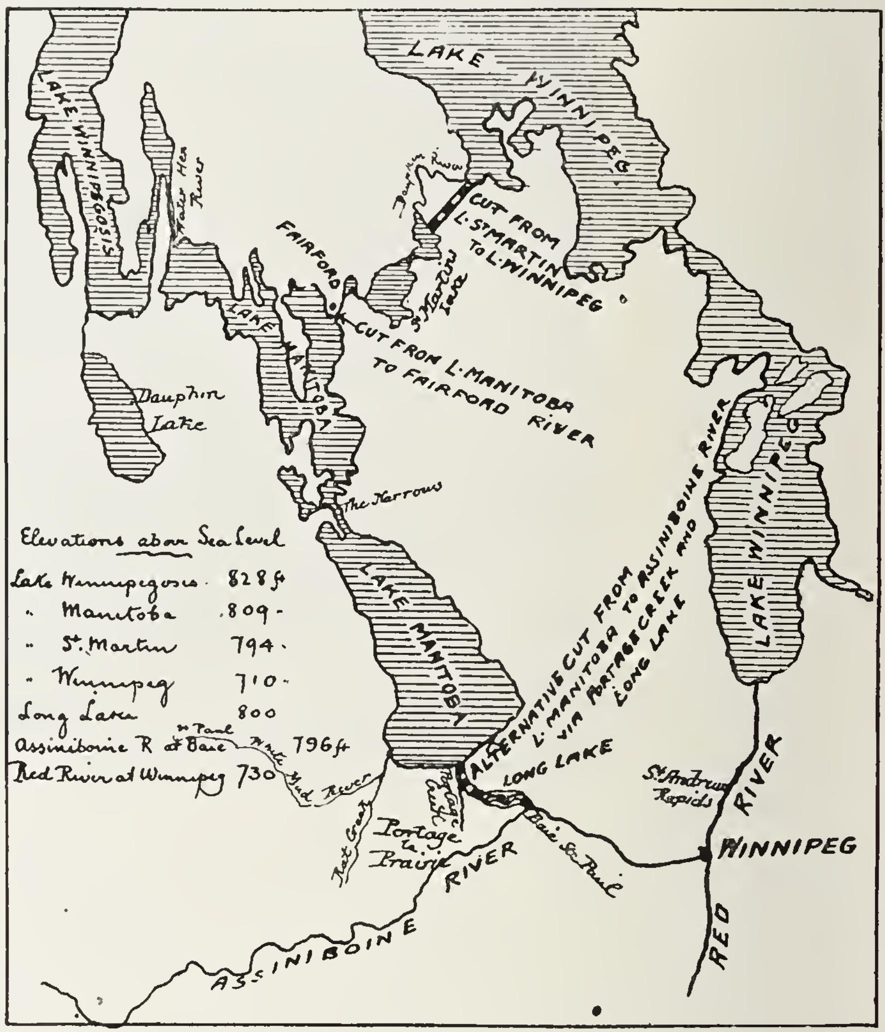
There are many defects that are likely to be found about a steam boiler and the ones most common are corrosion and grooving along the girth seams, generally on the bottom sheets and cracks extending from the edge of the sheet to the rivet holes. On the outside landing, this is more often found where heavy plates are used. The most serious form of corrosion is that which attacks the plates along the water level, forming a continuous line of weakness. This is, of course, due to the acids in the feed water, and can only be remedied by improving the supply. External grooving is often due to leaky calking and is very often caused by the use of what is known as a split calking tool having broke the skin of the metal. Buckled or boged sheets usually result from neglect in keeping the boiler clean. Soft deposits are allowed to accumulate over the fire and become hard, allowing the plates to become over-heated and be pushed down with the pressure. In iron boilers this has been attended by ruptures, while in steel boilers the buckled part grooves thinner at its lowest point until a small hole causes a leak.

I wish to mention before closing, a very important consideration about the steam boiler, and that is, the so-called mountings. How many boilers do we meet with that have a perfect working safety valve, one that will permit the escape of steam as fast as the boiler will generate it, and not allow the pressure to exceed at least 10 lbs. above what it was set for. Anything else is only an excuse for a safety valve. It is also quite a common thing to see water columns connected to the boiler with ½-inch and ⅜-inch pipe, and with three and four bends in it, and a small pet cock at the bottom to blow it out. This is another excuse. Also how often do we see a common plug cock put on for a bottom blow off. There are no mountings or fittings too good for a boiler, and none other should be used nor allowed to be used.

THE LAKE MANITOBA CANAL.

The question of lowering or controlling the water level of Lake Manitoba has been agitated for a number of years. The volume of water running into Lake Manitoba is considerably greater than the outlet capacity. A number of rivers and creeks flow into the lake, while its only outlet is the Fairford river to Lake St. Martin and thence via the Dauphin river to Lake Winnipeg. An important matter to be taken into consideration in connection with the lowering of the lake is its value as a navigable body of water. Some persons who have made a study of the question, claim that the lake is of greater value for purposes of navigation than the flooded land in its vicinity. The Winnipeg Commercial recently discusses the matter at some length, and we reproduce the accompanying illustration from its pages. Lake Manitoba is quite shallow, and if the water is materially lowered it will destroy navigation on the lake.

As early as 1881 the late Thos. Guerin, one of the most able hydraulic engineers in the employ of the Dominion Government, made an extended examination of the lake, with the object of discovering what could be done to reclaim the flooded lands and prevent a recurrence of the trouble. Mr. Guerin made a very full report as to the result of his work. He recommended that the outlet be enlarged by cutting a channel about two miles long, from the lake to the Fairford river, below the rapids on that stream. This would increase the outflow to Lake St. Martin. In order to provide for the carrying off of this increased inflow to Lake St. Martin, he also provided that another cut should be made from the latter lake to Lake Winnipeg, otherwise the country about Lake St. Martin would be flooded. Mr. Guerin found that 14,833 cubic feet per second of water was being discharged by the Fairford river into Lake St. Martin, while the outlet from the latter lake to Lake Winnipeg, via the Dauphin, or Little Saskatchewan river as it is sometimes called, is only 12,486 cubic feet per second. The land around Lake St. Martin, which is quite as valuable as the flooded territory around Lake Manitoba, was therefore also subject to flooding. To increase the outflow into Lake St. Martin without providing for an additional or larger outlet into Lake Winnipeg, would simply result in flooding the country around Lake St. Martin. Mr. Guerin estimated the cost of the short cut from Lake Manitoba to the Fairford river at $36,000, while the cost of the cut from Lake St. Martin to Lake Winnipeg he placed at $245,000, or a total cost of $281,000 to reclaim the 200,000 acres of flooded land around the lake.



The Commercial

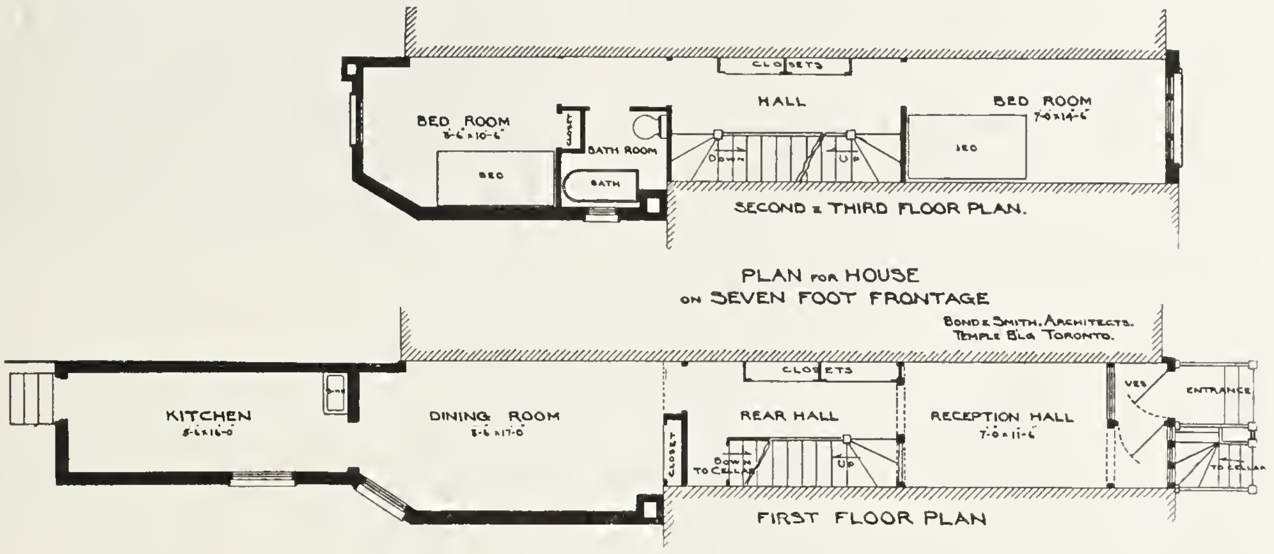
LAKE MANITOBA CANAL.

The Dominion Government, it now appears, has decided to go ahead and make the first short cut, without providing for the vastly more costly cut which it will be necessary to make to prevent the flooding of land around Lake St. Martin.

It seems to be agreed that Lake Manitoba might cheaply be part of a system of communication between the Red and North Saskatchewan rivers. The securing of navigation between Winnipeg and Edmonton via Lake Winnipeg is a matter of the utmost importance to the farmers of the Northwest. It is not necessary to abandon these lands in order to preserve the navigable value of Lake Manitoba. By the cutting of a canal from the southern end of Lake Manitoba to the Assiniboine river, the level of the lake can be reduced or regulated, and the flooding of lands in the Lake St. Martin region would be prevented. It would give such a flow of water as would greatly assist in rendering the Assiniboine river navigable between Winnipeg and Portage la Prairie; it would also improve navigation on the Red River between Winnipeg and Selkirk. It would give a sufficient flow of water to render it possible, The Commercial states, to develop a minimum of 15,000 horse-power on the Assiniboine river at Winnipeg. From Lake Manitoba to the Assiniboine river the distance across from the lake to the Assiniboine at Baie St. Paul is about seventeen miles. The fall is about fourteen feet. Long Lake forms a natural canal for about one-third of the distance, and Portage creek also forms a natural canal for a considerable distance from Lake Manitoba toward the Assiniboine river. The sketch map shows the Lake Manitoba basin with the outlet of the lake via Fairford and Dauphin river to Lake Winnipeg, also showing where the proposed cuts are located, whereby it is intended to lower the level of the lake. As noted, the intention is to make only the first short cut at Fairford now. This map also shows the alternative cut to the Assiniboine river, by which the level of the lake could be controlled as readily as by the two cuts at Lake St. Martin.

A VERY SMALL HOUSE.

This engraving shows plans prepared by Bond & Smith, architects, Temple Building, Toronto, for a house to occupy the narrow strip of land left in a city terrace to serve as a lane but no longer needed for that purpose. It will probably be the smallest modern house ever built in Canada.



A VERY SMALL HOUSE.

WIND MILLS AND PIPES.

BY WILLIAM PERRY, MONTREAL.

During the past few years considerable attention has been given to pumping machinery in its various details; and personally I have given it much time so as to derive from it information on a practical basis. Nothing is more generally disregarded in erecting a pumping outfit than the proper size of pipe, and the proper size of cylinder to be used with a particular size of pipe. Men, who for a number of years have had the old style wooden wind-mill running slowly, with pump larger than can be used on a modern steel wind-mill, do not realize that the pump for a modern fast running wind-mill, with a stroke twice as long, must have a reduced diameter of the cylinder, and a larger discharge pipe to carry off the greater quantity of water. With the old wooden wind-mill, which has 5 or 6 inch stroke, inch or three-quarter inch pipe has been used for the discharge without bad results; because the wheel has not had power to injure itself. You could hitch it to the pump rod, and it will stand like an old horse. I frequently have correspondence on the subject as follows: "I have been using my mill on one inch pipe with a 3-inch cylinder and 5-inch stroke for years, and do not see why I should change it to put in a fast running steel wind-mill. It did the work before the old mill wore out." It is quite the general belief that it is easier to elevate water 50 or 100 feet through one inch pipe than through 1½-inch pipe. The fact is not taken into consideration that while the weight of water in the 1½-inch pipe is 2¼ times as great as in the 1-inch pipe, still the water in the 1-inch pipe must be raised 2¼ times as fast, and by the increased speed there is more than six times as much friction.

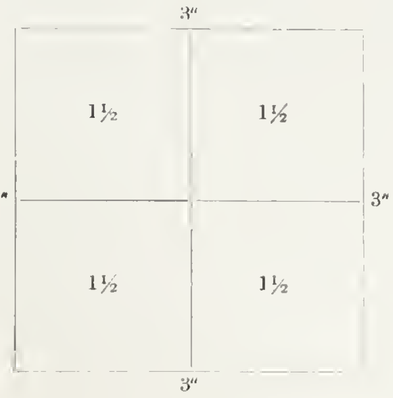


FIG. 1.

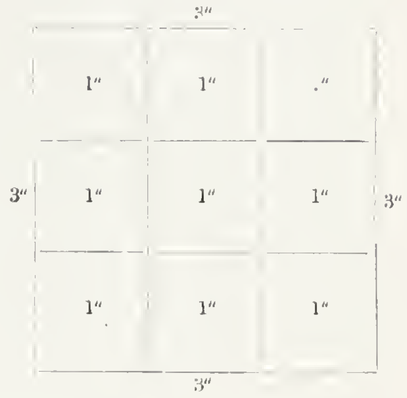


FIG. 2.

For the purpose of illustration, take a square cylinder and pipe, instead of round, the larger squares in the diagram representing the cylinder, and the proportions are between a 3-inch cylinder and 1½-inch pipe, as shown in Fig. 1, the area being four times the area of the pipe. Fig. 2 shows the proportion between a 3-inch cylinder and 1-inch pipe, the cylinder having nine times the area of the pipe. The same proportion exists between the cylinder and pipe of the usual form having corresponding diameters. As a consequence where 1-inch pipe is used with a 3-inch cylinder the water must rise in the pipe nine times as fast as it rises in the cylinder. When it is taken into consideration that an 8 foot steel wind-mill with 8-inch stroke at its maximum speed will travel 48 feet per minute, or on the down stroke 24 feet, it is plain that with a 3-inch single acting cylinder, with 8-inch stroke, and 1-inch pipe, the water in the pipe must travel 216 feet per minute. Taking into consideration the fact that friction increases according to the square of the velocity it will be seen that it is necessary to reduce the speed as far as possible by using larger pipe.

In comparing the proportionate speed in different sizes of pipe used in connection with 3-inch cylinder with 8-inch stroke, and the proportionate amount of friction in raising water 50 feet vertically with the same cylinder, it must be understood that this proportion is for a direct lift of only 50 feet—in forcing water long distances the friction in small pipes would be very much more. For instance where water is to be forced 2,000 feet horizontally to an elevation of 50 feet, using a 3-inch cylinder with 8-inch stroke and 1-inch discharge pipe, the least possible friction under the most favorable conditions with check valve and straight pipe, and a large air chamber, would require as much power as to raise water with the same cylinder and pipe vertically 193 feet. In actual practice the circumstances could not be found to reduce the friction to so small an amount if no air chamber is used or if it is insufficient, and there are several elbows or short turns in the pipe. The friction will amount to a lift of from 4 to 600 feet; by using 1½-inch pipe under the same conditions, the friction with everything in a satisfactory state would be reduced so that the total power required would equal a vertical head of about 72 feet, which is so reasonable an amount that it would not endanger the safety of the plant. The use of 3-inch pipe under the same conditions would be a barely noticeable change. I have repeatedly had such arguments as follows advanced: "I operate my pump by hand with ease, and it will not work as well with the wind-mill." This does not necessarily follow in operating by hand. The stroke is much slower and the power applied not as positive. If the pressure becomes too great the man will work more slowly and will often stop to rest. The wind-mill works right along and the stronger the wind the greater the pressure and the less possibility of checking the speed. Wind as a motive power for driving machinery and pumping water now occupies a large field, and the improvements recently made render the wind-mill more reliable, and in action less liable to damage by storms, as it is self-governing. These mills are used for pumping water, grinding, sawing wood, etc. They are most efficient in exposed situations, but they can be utilized anywhere if placed at an elevation where they can get the full force of the wind. It is necessary to have a storage reservoir capable of holding six or eight days' supply of water when they are relied on as the only source of water supply.

AUTOMOBILE PROGRESS.

The December developments in the matter of mechanical traction have been strikingly sensational. For the first time in the history of the horseless carriage enterprise in the United States the daily papers have had the opportunity of recording genuine transactions on a large scale; and these have been of such a nature as to discount the policy of ridicule which on the part of the English newspapers has retarded the progress of the enterprise in Britain. An American journal recently remarked that the motor carriage problem would find its solution in the United States, the common roads in that country being so atrociously bad that mechanical vehicles that were able to navigate them could go through anything. This is rather rough on the road-makers, though a compliment to the motor makers. Up to date the prediction has not been fulfilled; yet recent photographs of American rigs, run by both gasoline and electricity, show them successfully ploughing through mud, slush and snow during the recent storm in Boston, Chicago and New York, while it is notorious that the automobile cabs in New York stayed out on the streets when cab horses were unable to fight the elements, and street traffic generally was demoralized. The most notable development of the month, because it is undoubtedly genuine, and backed by ample capital, is the purchase of the Fifth avenue stage line in New York. This line has been in the hands of a receiver for some time, its manager being W. G. A. Hemming, formerly of Toronto. The 'busses, about 100 in number, were in a rather dilapidated condition; but under the new management the old equipment and hack horses will be cleared out and electrical omnibuses put on the avenue. There never was such a splendid opportunity for automobiles. Fifth avenue is asphalted for nine miles, has no grades exceeding 10 per cent., is the thoroughfare for the wealthiest New York people, and as The Electrical Engineer remarks, "the line should prove a howling success." The three purchasers of this old Stage Line are millionaires many times over, and represent a wealthy corporation—the Third Avenue Railroad Company—that intends to extend its franchise the entire length of the avenue, thus allowing transfers to the cable road on 125th street, and reaching also the Desbrosses street ferry. There is some talk of the new proprietors installing compressed air; but this is not likely in view of the fact that the company now runs a magnificent electric plant in connection with its street car system, and could thus charge the batteries for the auto-cars at a nominal cost. Prof. Louis Duncan of the Johns Hopkins University, Baltimore, is in conference with the new owners of this Fifth avenue line as to electrical installation. Joseph Leiter, jr., who made such a sensation a few months ago in the Chicago wheat pit, is exploiting compressed air for all it is worth—and a great deal more. He has got control of the foreign patents on the Knight-Hoadley system, and is asking for them the modest sum of $100,000,000. The English journals thus far are poking fun at him in all directions. In New York the compressed air system is reported to be having a boom in the form of "auto-trucks," which are to be run on the streets, and one enterprising journal gives an illustration of the new vehicle, which seems to be a cross between a traction engine and a street car. From the most reliable reports we can gather, the fact appears to be that President Vreeland, of the Metropolitan Traction Company, is going to give compressed air a trial. At present it stands about on a par, for traction purposes, with an enormously heavy battery, but lacking the long series of experiments and the mass of data which are available in connection with its heavy rival. In comparison with hydro-carbon propulsion, compressed air is nowhere, and we predict that it will never get a footing as a tractive power.

NEW OFFICE BUILDING OF THE GRAND TRUNK RAILWAY SYSTEM, MONTREAL.

The month's news has been enlivened by "scare-heads" in the newspapers giving elaborate accounts of the movements of a lively French Count, named Jotemps, who, it appears, represents a European company that seeks to control the entire output of automobiles. This is a large contract indeed. The United States newspapers, which tell (on the authority of Mons. Jotemps), that the American motor patents are the only ones that are of any value, seem utterly oblivious of the fact that the Frenchmen have the lead of the Americans by some years, are pushing enlargement of their factories at tremendous speed, command unlimited capital, and have legislated a prohibitive duty on all imported motor vehicles. The newspaper report, however, is that the French Count has contracted with all the American auto-car manufacturers for a large number of automobiles per year for ten years, the total amount of his purchases running into fifteen millions of dollars! This is a good piece of news—almost too good to be true, in view of some facts which we happen to know. Here is one: Mr. Jenatzy, with his ordinary electric vehicle, with accumulators weighing 1,800 kilos. (say 4,000 lbs.), developed 28 horse-power in going up a steep hill on a wet day at a speed of nearly 30 kilometers an hour. Per contra: An American electric vehicle with battery weight over 1,400 lbs., going up only 10 per cent. grade, could not develop power sufficient to carry itself up empty, its total weight being only 2,700 lbs., and not an ounce of load except the driver! Yet the makers of this American vehicle claim to have sold the French Count five million dollars' worth of their vehicles. Until we have some corroboration from a reliable source, we must treat the French Count and his exploits as a romance,

In France the motor carriage industry is going rapidly. One firm alone—that of DeDion and Bonton—has orders on hand aggregating $600,000, and others being added daily. Of this total, $125,000 worth are from Germany. The factory is turning out each month a total of $100,000 worth, and enlargement of premises is being made so that 2,000 workmen will be employed, and the monthly output increased to $300,000. In England the London Electrical Cab Co., and the Motor Van and Wagon Co. have made reports to their shareholders, which are to a considerable extent satisfactory, but not indicative of the vivacity which characterizes the French makers. Mr. Pennington, the American inventor, whom The Canadian Engineer has paid some attention in past years, seems to be having the call in England now, orders for 376 of his gasolene motors having been received within the past few months. The report of the British commissioners for light railways shows quite a boom in electric tramways. Of the 54 applications during November, the motive power of 32 is electricity and 22 steam.

Joseph H. Leiter has secured control of the Rhode Island Locomotive Works, and the company capitalized at $7,000,000; will employ 1,200 hands day and night, and will make 50,000 trucks for New York and Brooklyn at $2,000, and 70,000 for London, whither Mr. Leiter goes in February to arrange for the consignment of output. It has been cabled from Europe that the municipal council of Stuttgart, Bavaria, has passed a law forbidding the use of horses for trucks or heavy freight wagons within the city limits, the automobiles having proven very successful. Even the farmers are interested in them.

PUBLIC OPINION.

Editor Canadian Engineer :

Sir.—I have received your card of the 19th inst. and have carefully and profitably noted your remarks regarding the elements of nature as well as those of the publishing business. I would add concerning the latter that there is another element quite as important, if not more so than the two you have mentioned—namely, brains, or what is perhaps synonymous with brains—enterprise. During the time I have been a reader of your excellent publication, The Canadian Engineer, I consider that you have furnished this most indispensable element. I, therefore feel it not only a duty but a pleasure to supply you with my portion of that other essential, which you have a right to expect from your subscribers, and accordingly enclose herewith postal note for $1 to renew my subscription for 1899.

Yours truly, F. R. Wilford.

Iroquois, Ont., Dec. 20th, 1898.

SHERBROOKE GAS AND WATER CO.

The Sherbrooke Gas and Water Co. has recently started up its new water power equipment, and has found it very satisfactory in operation. The new plant was designed to largely augment the company's facilities for supplying electric light and power, there being an increasing business in sight, one contract, for example, being the electrical driving of the machinery in the new shops of the Quebec Central Railway at Newington, when completed. The construction and installation of the water power machinery as a whole was placed in the hands of the Jenckes Machine Co., Sherbrooke, and the finished work reveals an excellent example of progressive ideas and good workmanship. Two 40-in. Crocker turbines in horizontal setting are contained in one steel case, 10 feet in diameter, and over 20 feet in length, and are supplied with water under 31 feet head from the dam some 70 feet away, by two feeder pipes, 80 inches in diameter. Each wheel will develop 518 h.p. The whole wheel case and shafting is supported by steel girders and solid masonry. All bearings are of the self-oiling ring type, and the gate mechanism is operated from a suitable point in the dynamo room overhead. The main driving pulleys located at each end of the wheel case are 108 inches in diameter, 36 inches face. The weight of the entire plant is about 125,000 lbs. Taken altogether, the starting up of this plant marks an important point in Sherbrooke's industrial history, and emphasizes the ability and energy of both of the companies concerned, the one in promptly keeping pace with a growing business, and the other in furnishing the necessary means to this in the shape of an equipment so thoroughly constructed and fully in line with the latest practice.

THE YUKON GOLD DEPOSITS.

The Department of the Interior has received from the Geological Survey a preliminary note on the gold deposits and conditions of mining in the Klondyke region by R. G. McConnell and J. B. Tyrrell of the survey staff. They say that the productive part of the Klondyke gold district as at present known covers an area of 1,000 square miles, and is situated between the Klondyke and Indian River tributaries of the Yukon, and east of the latter river. The approximate area of 1,000 square miles of the known gold fields refers to the district traversed by the gold-bearing creeks, and not to the actual area of pay gravels. The latter are confined to the bottoms of a few of the valleys and the lower slopes of the adjoining ridges, and occupy a much smaller area. The gold occurs in the gravels flooring the bottom of the valleys, in stream terraces lining the lower slopes of the valleys, and in a remarkable moraine or glacial deposit which forms a southern slope of El Dorado and Bonanza Creeks for some miles, and which was also found north of the latter creek for some distance above its junction with El Dorado. The stream gravels have a thickness of two to eight feet, and a width along the most productive portions of El Dorado and Bonanza Creeks of from 100 to 400 feet. They extend across the valley bottoms and increase in width with the gradual enlargement of the latter towards their mouths. The gravels are everywhere more or less auriferous, but the concentration is irregular and the gold increases in quantity towards the bottom of the section. The greater part of the pay is usually found within a foot and a half or two feet of bed rock. A considerable portion of gold is also found in the soft decomposed and shattered country rock, on which the gravels rest, into which it has sunk often to a depth of two feet. The bench gravels are of less importance than the stream gravels, and, so far, are only worked to a considerable extent along Bonanza and along the lower part of El Dorado Creek. The benches only occur at intervals along the sides of the valley, and, as a rule, are rock-cut and not built up by stream deposits. They are found at varying heights, up to an elevation of 75 feet or more above the bottom of the valley. The gravels are mixed with sand and consist of flat and sub-angular pebbles of schist, often a foot or more across, and rounder than quartz pebbles. The gold is fine, but nuggets up to a value of $1.35 are reported to be found. The average yield of the bench gravels is stated to vary from five cents to twenty cents to a pan.

Discussing the probable sources of placer gold, Messrs. McConnell and Tyrrell say that the gold in its original habitat has beyond doubt been associated with quartz, for many masses of gold-bearing quartz have been found and many of the nuggets of gold contain particles of quartz. Whether the gold is chiefly derived from the heavy veins or from the narrow stringers has not yet been determined, but it is probable that in places both are auriferous. They found gold in a thick quartz vein north of El Dorado Creek, but as the abundance or scarcity of placer gold did not appear to depend on the size or number of these heavy veins, it is probable that the precious metal has been chiefly derived from the narrow stringers or leaves of quartz interbedded in the schist. The great ice sheet of the glacial period, which covered much of British Columbia, did not reach as far north as the Klondyke district, so that ever since the land was elevated above the sea, perhaps in the Miocene or Pliocene epoch, it has been cut down by atmospheric and stream agencies into deep valleys and rounded hills, the surfaces of which are covered by varying thicknesses of decomposed rock. There is no doubt that much of this decomposed rock in the Klondyke area contains a small amount of gold, and by constant washing for ages much of this has become concentrated in the beds of the streams. Nor can it be doubted that the work of concentration has been greatly expedited by small local glaciers, which at a period not very remote, have originated at the heads of these creeks and have filled the bottoms of the valleys through part, at least, of their lengths. The higher so-called benches have been formed either as lateral moraines along the sides of the glacier or by streams which flowed between the side of the glacier and the bounding slope of the valley. The great richness of the Klondyke placer ground depends, therefore, first, on the presence of a highly gold-bearing rock, and, secondly, on the occurrence of a set of conditions peculiarly favorable to the concentration of the precious metal.

—Wireless Telegraphy Across Paris is a recent article by Ducretet. He describes experiments in transmitting messages from the Eiffel Tower to the Pantheon, a distance of 2.5 miles; the direct view is interfered with by many aerial structures. The results obtained were perfectly clear, even in a thick fog. The signals could be read by their sound with great ease, or could be recorded, but no results were obtained in endeavoring to transmit in the reverse direction from the Pantheon to the Eiffel Tower, owing to the mass of metal in the latter.

A GREAT WATER POWER CENTRE.

If the 19th century may be called the American age, because it is that of steam, in which our southern neighbors have distinguished themselves, the 20th century bids fair to be styled the Canadian age, because that of cheap electricity, which can only be generated through cheap power. Nothing is cheaper than nature, and this Canada of ours is the most watered portion of the continent. Our attention has lately been drawn to a section of the Dominion which seems to have been richly endowed by nature in the shape of water power. We mean Northern Quebec, where streams of immense volume come down the slopes of the Laurentian mountains. U. Barthe, secretary of the Quebec Bridge Co., has devoted much time to a personal inspection of the larger waterfalls of his district, and has communicated us a summary of the information thus collected, which may interest not only the engineering profession, but also the capitalists of this country, in view of the cheap production of wood, pulp and paper, calcium carbide, and also the use of storage batteries. The city of Quebec itself is surrounded by a remarkable water power system, the principal instances of which are: The Montmorency Falls, the property of, and operated by, the Quebec, Montmorenci & Charlevoix Railway Co., nine miles below the city, minimum power in lowest water with present plant, 5,000 h.p. with a head of 250 feet. They actually run the city electric light and power, the city electric railway, and the two factories of the Montmorenci Cotton Mnfg. Co., and the Riverside Manufacturing Co., and will next summer operate the railway to Ste. Anne de Beaupre, which, with the city system, will make over 60 miles of railway. The Chaudiere Falls, six miles above the city on the south shore; property of the Canadian Electric Light Co., now preparing to develop them; minimum summer capacity estimated at over 5,000 h.p.; head, 110 feet. The Grand Falls of St. Ann, 24 miles below the city, also the property of the Canadian Electric Light Co., estimated to develop regularly about 7,000 h.p.; head, 190 feet. Four or five miles above the Grand Falls, and on the same river, St. Ann, are the beautiful Seven Falls, already mentioned in this paper; total head, over 500 feet. The Valcartier Falls, on the Quebec & Lake St. John Railway, 20 miles northwest from the city; at present in course of development by the Jacques Cartier River Power Co., under contract with Ross, Barry & Co., of Toronto; estimated capacity at least 5,000 h.p. The St. Maurice water power system, actually operated or about to be developed, consists of the Grande Mere Falls, 10,000 h.p., operated by the Laurentide Pulp and Lumber Co.; the Shawinigan Falls, where the Shawinigan Water & Power Co. has let a contract of $260,000 to Ross, Barry & Co. for a first development of 30,000 h.p., with possible increase to 150,000; the Gres Falls, which will be utilized as soon as the Great Northern track reaches them. This railway will then strike the Maskinonge river, where very powerful falls also exist. In the Lake St. John and Saguenay region are several waterfalls of first magnitude, viz., the Ouatchouan Falls, height 225 feet; the Metabetchouan, the Ashuapmouchouan, the Mistassini and the Peribonka Falls, all flowing into Lake St. John, and now of easy access by rail and boat; the Grand Discharge and the Saguenay Rapids between the lake and the town of Chicoutimi; and last but not least, the 10,000 h.p. falls of Chicoutimi river, already operated by the Chicoutimi Pulp Co. Other large waterfalls are reported to exist on both rivers, Manitou and Marguerite, on the North shore of the St. Lawrence below the Saguenay, one of which of an estimated capacity of 100,000 h.p., is to be worked up, it is said, by Geo. Taylor, Toronto. A careful estimate, generally considered very conservative, and limited to the dry season minimum, and to the points now accessible by rail or water, puts down at 250,000 h.p. the amount of water power available in that part of the country, of which only a very small portion is now being developed.

GRANDE MERE.

The plant of the Laurentide Pulp & Lumber Co. at Grande Mere, as seen a few weeks ago before the opening of the paper mills, comprised a high grade masonry dam, with 15-foot feeder pipes connected with 14-foot water wheels in the paper mills; a large stone-built pulp mill; a saw mill; a massive group of brick buildings, consisting of a 215x60 foot screen house, a 210x60 foot beater house, annexed at right angles to the paper mills installed in two parallel two-story galleries of an equal size of 200x70 feet, the paper machinery proper being Pusey & Jones' machines, of Wilmington, Del., and the finishing and packing room, 170x60 feet; the acid tower, 40 feet square and 146 feet high, built on the edge of the hill, and containing nine vertical tubes of 3 feet diameter for preparing lime; the sulphur house, 160x25 feet; the filter house, 50x80 feet; the digester house, 90x70, besides the company's stores and offices, the machine shops, water reservoirs, rail elevators, coal slides, steam log drivers, freight sheds, etc. All the buildings, save the acid tower, are lighted by electricity, and are fire-proof, with arched brick floors and slate roofings. The Sturtevant heating system is exclusively used in the paper mills. Provision has been made as to space and power for future enlargement of the mills. During construction, the number of men employed has reached 1,400. The mills in operation will employ an average of 800 to 900 hands. A little town has grown on the adjacent hill around the mills; the population is now estimated at 2,500. The daily capacity of the Grande Mere mills is 40 tons news print, 100 tons dry pulp, 35 tons cardboard, and 50 tons sulphite pulp, and their daily consumption is given at 50 tons coal, 10 tons limestone, 15 tons general goods and 200 cords of wood. Grande Mere is a station of the Great Northern, giving direct connection with Quebec; to reach Grande Mere, the trains cross the St. Maurice on a beautiful cantilever bridge, about a mile below the Falls. Connection is made at Garneau Junction with the C.P.R. on Three Rivers.

PROPOSED DEVELOPMENT OF SHAWINIGAN FALLS.

The plan designed by T. Pringle & Son, civil engineers, Montreal, and on which a contract has been signed with Ross, Barry & Co., specifies the immediate development of 30,000 h.p., which may be hereafter increased to 150,000. The work is described as follows: Truss, boom and cribwork across the river, a little distance above the Falls, such boom of sufficient depth and at such angle as to deflect all floating ice debris over the Falls. Head race or inlet canal from truss boom in westerly direction, said canal to be 1,100 feet long, width varying from 100 to 400 feet at the entrance, excavated to such a depth as to contain in all seasons not less than 16 feet of water, with a speed inland of two feet a second for the 30,000 h.p. development. Banks of head race to be protected where too low with cribwork piers, dry stone walls and filling embankments. Bulkhead or dam of high grade concrete masonry, and fitted with suitable racks and steel inlet gates for feeder pipes, said bulkhead to be carried well up above the flood level. As to feeder pipes, first development contemplates installation of three large pipes of 13 foot diameter each, and one smaller pipe 4 feet diameter for operating compressors and exciters, the large ones having each a capacity of 10,000 h.p., and the latter about 6,000 h.p., all pipes supported at suitable intervals by heavy masonry saddles built in cement mortar. Distance between bulkhead and power house about 500 feet. The power house foundations are built up with massive bed of concrete masonry, arched for feeder pipes, tail race, etc. Power units in first development consist of two turbines on horizontal shaft, direct connected to 5,000 h.p. generators of modern design. Two of the power units to be supplied from each feeder pipe; 120 feet is the nominal head under which turbines will operate. Provision is made for heavy valves between feeder pipes and water-wheel cases, and it is contemplated that all valves will be controlled either by pneumatic or hydraulic pressure. All feeder pipes will be provided with suitable air cushions and relief valves to take up any possible water hammer.| Power house building to be a substantial steel frame building, filled in with brick and equipped with suitable traveling cranes to handle all the heavy apparatus. From power house into lower bay the plan provides for a tail race of sufficient capacity, the sides of which will be protected with rip rap masonry. The whole work to be of a most substantial and permanent character and design. The head race bottom, foundations of bulkhead, supports of feed pipes and powerhouse foundations to rest on solid rock. The future extension contemplated may consist of widening the inlet canal on one side inland, and extending bulkhead and power house in the same direction, and further extension can still be made by constructing bulkheads in upper bay carrying feeder pipes at different points and discharging in lower basin or in the mouth of Shawinigan river.

OTTAWA SHIP CANAL.

Editor CANADIAN ENGINEER.

It may be news to some of your younger readers that a survey of the Ottawa for a ship canal was made in 1855; and work upon it, near Arnprior, performed in 1858. The canal was located (for a political effect) on the Quebec side of the Rapides des Chats; but the rock proved so very hard and tough that little was effected at the time. The site for a canal is an ideal one, being almost an air line from the Straits of Mackinac to Montreal; the water supply is quite sufficient, except on the watershed between the French and Ottawa waters, near North Bay; while the general character is that of a series of lake-like expanses, separated by narrow ridges of rock, causing rapids. Thus French River, forming 80 miles of the route, needs only one lock, with a lift of 5 feet in the first 30 miles; and two 10 feet lifts bring us to the only cataract of 25 feet in a hundred yards, about ten miles from Lake Nipissing, which affords 20 miles more of free navigation about 18 feet deep. From North Bay to Trout Lake (emptying into the Ottawa), is 4 miles, with a rise of 19 feet, along a small river, affording a canoe route with a very short portage over a low flat rock. The descent of the Mattawa is the most difficult portion of the whole route, nearly all the cuttings being in Laurentian rock, and the rapids frequent. The water for lockage, too, might be scant for a ship canal. From Mattawa village to Pembroke, the bed of the Ottawa is generally a swift current, with frequent rapids, calling for a number of locks; but a few large dams may alter this portion materially for the better. From Pembroke to Ottawa city the greater part of the way consists of lakes separated by ridges of rock forming at Fitzroy Harbor a semi-circle of cascades nearly three miles in extent, with a fall of about 30 feet. The capacity of such a location for the development of power is almost beyond computation. Between the mouth of French River and Ottawa city probably a million horse-power might be developed and utilized, and thus give birth to a chain of manufacturing towns, similar to what has grown up along the Welland canal. Indeed, when the climate, minerals and timber are considered, with the shorter route to European markets, the advantage is decidedly in favor of the Ottawa canal system. Thus much in favor. On the other hand, it will cost a good deal to ensure a constant channel through Lake Nipissing, whose bottom consists of laurentian gneiss, overlaid with shifting sands, and subject to frequent gales. The long swift current between Mattawa and Les Alumettes Lake will be costly to deepen and regulate, while the rafts of timber will claim right of way for many years and impede navigation to some extent. The length of the season free from ice will be seriously curtailed in the vicinity of Mattawa, its most northerly angle. As a native of the Upper Ottawa, and long familiar with French River valley, I will earnestly hope that such a Klondyke of undeveloped possibilities—commercial, manufacturing, mining and agricultural—may yet prove Canada's brightest diadem.

THOMAS FROOD.

LITERARY NOTES.

The Niagara Falls, Ont., Record issued a special Christmas number this year of 20 pages, which is profusely illustrated, and also contains a history of the neighborhood, which is very interesting.

We have received a copy of the President's address for 1898, of the American Society of Mechanical Engineers, being a reprint of part of Vol. XX. of the published Transactions of the Society. Chas. Wallace Hunt, the president, discusses the subject, "The Engineer; his work, his ethics, his pleasures."

Theatre Sanitation, by Wm. Paul Gerhard, C.E., is an interesting pamphlet which contains the paper read at the meeting of the American Public Health Association at Ottawa, and is reprinted from The Sanitarian for December, 1898. Therein the theory and practice of theatre sanitation is taken up under the following heads: Drainage, plumbing, water supply, ventilation, lighting, general sanitation. Mr. Gerhard is also the author of a very interesting work of 500 pages, entitled Sanitary Engineering of Buildings; published by Wm. T. Comstock, 23 Warren street, New York, N.Y.

We have received a number of very handsome calendars for 1899, among others from the Boiler Inspection and Insurance Co., Toronto; the B. Greening Wire Co., Hamilton, Ont.; John Bertram & Sons, the Canada Tool Works, Dundas, Ont.; A. F. Bury Austin, lumber and timber, Montreal

The Dodge Mnfg. Co., Limited, York street, Toronto, has sent us a copy of the 100 page catalogue which is issued from the office of the Dodge Mnfg. Co., Mishawaka, Ind., U.S. The catalogue is very finely illustrated with a large number of photo-engravings, which show the various applications which may be made of the rope method of transmitting power.

We have received a pamphlet of some 20 pages containing a graphical method for constructing the catenary, with exact drawing board constructions for all cases of the problem of plotting the curve of a flexible cord of uniform weight; including a review of notable properties of the curve with their graphical representations, by Walter K. Palmer, M.E., School of University of Kansas, Lawrence.

The Intelligencer, Belleville, Ont., has issued an almanac of some seventy pages, which contains all the information usually found in a volume of this kind. In the space usually occupied by jokes, The Intelligencer almanac has printed copious extracts from its own editorial columns, and those of its leading contemporaries, under such headings as, "The Political History of 1898," "General Postal Regulations," "The Public Debt," "The Preferential Trade Failure."

The Philadelphia Museum is a national and international bureau of commerce, with large libraries of foreign government documents, with a public journal room containing over eleven hundred journals, and with an immense museum drawn from every country in the world. The periodicals are constantly referred to by persons in search of specific information. The Canadian Engineer is always to be found in the reading room. The Philadelphia Commercial Museum has recently issued a pamphlet stating the objects of the museum and giving a list of its officers.

Walter K. Palmer M.E., School of Engineering, University of Kansas, Lawrence, has published "The Designing of Cone Pulleys; a non-approximate graphical solution for the problem of proportioning cone pulleys," with concise practical rules. The following are among some of the heads under which the discussion falls: General Analysis, Case I., Open Belts; Case II., Crossed Belts, Comparison of Existing Methods; the Reuleaux Analysis, the Final Diagram, Analysis for Crossed Belts, Rules for Proportioning the Steps of Cone Pulleys, Special Rules for Small Three-Step Cones.

The January number of The Canadian Magazine contains an article of great interest on "Great Britain vs. United States," by R. E. Kingsford. This is a thoughtful and well-considered attempt to throw light on the present craze in England for an alliance with the United States, and its bearing on Canada. The continuation of Johanna E. Wood's story "A Daughter of Witches," sustains the interest of the reader. The only flaw in the number is a mass of biographical details of second-rate actors, who were not, thank goodness, born in Canada. Such matter should be found only in ten-cent magazines.

NEWFOUNDLAND NOTES.

Some time ago J. S. McLennan, treasurer of the Dominion Coal Co., proceeded to Newfoundland to look into some iron deposits owned by his company, as well as to examine the large iron deposits at Belle Island, owned and worked by Graham Fraser and others for the Ferrona Company, of Pictou. A Newfoundland informant states that Mr. McLennan has succeeded in purchasing the Ferrona areas, as well as several other smaller areas north. Mr. McLennan has also made arrangements for the mining, next season, of 2,000 tons per week of the ore.

The St. Johns Herald stated recently that another great discovery of copper has been made in Green Bay, samples of which, on analysis, were found to yield 43 per cent. of the mineral. In evidence of the splendid position of Newfoundland copper in the British markets at present, we may quote the following extract from The London Financial Times, of Nov. 9: The SS. "Regulus" arrived at Swansea on Monday from Little

Bay with the first cargo of copper ore raised in Newfoundland by the company. The consignment has been sold by Messrs. Henry Bath & Son at the top price of the day. Another cargo, which will be loaded as soon as the open water permits, is expected shortly.

Hon. Capt. Kean and H. D. Reid have returned from Glasgow, where they arranged for the building of the fleet of seven steamers called for by the Coastal mail service which forms a feature of the Reid contract. The steamers are being built with a view to the future development of the services and not to the existing conditions. They are all to be finished exactly like the "Bruce," both in their structure and interior fittings. They will be specially fortified to resist ice; they will have the very latest devices in machinery, their equipment will include electric search-lights, etc.

BRITISH SEWAGE COMMISSION.

In reply to enquiries by The Canadian Engineer regarding the issue of the report of the Royal Commission on Sewage Disposal, now sitting in England, a note from Lord Iddesleigh sets right some misconceptions on the subject. His Lordship, who is chairman of the commission, says: "It has been brought to the notice of the Royal Commission on Sewage Disposal that there is a tendency on the part of some manufacturers and local authorities to postpone the carrying out of woks for the purification of trade refuse and sewage until the Commission have issued their report, and I, therefore, think it desirable to state that a considerable time, perhaps even some years, must elapse before the Commission can arrive at any final conclusions on a subject which necessarily involves detailed and prolonged scientific investigation. Any such postponement would be viewed by the Commission with the gravest concern."

FIRES OF THE MONTH.

Dec. 8th. Northern Pacific and Manitoba Railway coal sheds, Belmont, Man.——Dec. 17th. Ontario Wind Engine & Pump Co.'s works, Toronto; damage, $3,000; fully insured.——Dec. 17th. The Toronto & Hamilton Sewer Pipe Co.'s Works, Hamilton, Ont.; damage, $35,000; insurance, $25,000. Dec. 21st. S. Greenshields & Co.'s dry goods warehouse, Montreal; loss on it and adjoining properties almost $1,000,000.——Dec. 20th. The Gardner Tool Co.'s premises, Sherbrooke, Que.: damage about $25,000.——Jan. 2nd. Toronto Rubber Shoe Manufacturing Co.'s factory at Port Dalhousie, Ont.; damages between $75,000 and $100,000.——Jan. 5th. Louis Brousseau's gas and electric lighting plant, St. Hyacinthe, Que.; damages about $10,000; partly insured.

THE DEPARTMENT OF CHEMISTRY, McGILL UNIVERSITY.

The magnificent building devoted to chemistry and mining in McGill University, whose equipment has just been completed through the generosity of W. C. McDonald, whose gifts to the University have been so large and bestowed with such a wise discretion that McGill has been left in many directions with nothing to wish for. The portion of the building devoted to mining and metallurgy was described in The Canadian Engineer for June, 1898. The chemical department was opened with imposing ceremonies by Lord Strathcona and Mount Royal, Dec. 20th.

The chemistry building is now largely equipped and all the work of the chemistry department is being done inside its walls. The equipment is already extensive, but it is far from being what its managers intend it shall eventually become. Four floors in the new building are occupied by the laboratories, museums, class-rooms, offices, etc., and a fifth story, lofty and spacious, is designed for store rooms. Every part of the building has its separate connection with the ventilating fans in the roof, for the purpose of ordinary ventilation and for the speedy removal of the poisonous gases, etc. Internally the walls are finished largely in pressed and enamelled brick, with a free use of tiling both for floors and walls. The frames of the stairways are of iron, in ornamental designs, with slate steps, making them fire-proof. The floors are mainly of polished hardwood, and handsomely finished wood has been employed in the ceilings. Several colors of enamelled brick are used in the halls and on the stairways, giving very pretty effects in the borders. Perhaps the handsomest portions of the interior are the entrance hall, the library and reading-room, the ladies' room, the large lecture theatre, and the private rooms of the professors. The entrance hall has a handsome mosaic flooring, and walls partially covered with beautifully grained and colored stone.

The library, with its cosy alcove corner gives a pretty effect. The floor, ceiling and fixtures are of light-colored wood, highly polished, and the walls are of a deep, soft red color, with borders of a creamy yellow tint. The electric light fixtures are of brass; the design is a very handsome one. The steel beams of the ceiling are cased in beautifully grained spruce dividing the expanse into square panels, bordered exquisitely in wood. The ladies' room offers to the students of the Donalda department more luxurious accommodation than any other part of the university. Dr. Harrington's rooms, situated next to the library, are similar to that apartment in finish, and, like the library, are very well lighted. The lecture theatre has ceiling, floors, seats and fixtures of oiled wood, very light in color, and in the walls cream and white bricks are largely used, the whole giving a marvellously bright effect. High up on the walls in a border of ornamental brick and tile in separate panels, are recorded the names of the greatest chemists at different stages in the development of the science. This border runs around three sides of the room. Above the platform is inscribed the name of Geber, the most illustrious of the chemists of the alchemistic order, which was in its prime in the eighth century, when chemical experiments were carried on mainly for the discovery of methods of making precious metals and stones. Following this came the Iatrochemical period, when the science was in the hands of men who delved into its secrets with a view to finding medicines for the cure of diseases. Then came the period of the Flogiston theory, represented on the walls by the name of Stahl, one of the greatest exponents of that famous but unsupported belief. The name of Lavoisier, who struck the secret of combustion, marks the beginning of the modern period when chemistry began to be studied along the present broad lines. Lavoisier, by the way, was beheaded during the French revolution. Some of the names inscribed of the great chemists who have become famous since are, Davy, Dalton, Gay, Lussac, Faraday, Wohler, Liebig, Bunsen, Hoffman and Fresenius. A lantern is also included in the lecture room equipment as lantern slides are used to illustrate the lectures. The theatre will accommodate 250 students.

An enumeration of the rooms of the building gives some idea of the work which is carried on. Beginning at the bottom and omitting mention of the mining department's quarters at the rear, there is the sub-basement. Here are set up the furnaces for the heating of the building and a fan room from which fresh air is forced through many flues into every part of the building. A clever device has been used to heat this air. The exhaust steam from the engines in the engineering building is brought over and entering clusters of coils heats the fresh air as it enters the buildings. This action condenses the steam and the hot water resulting is automatically conveyed back into the boilers whence it came. On the next floor is the lower entrance to the lecture theatre and adjoining the theatre the rooms where are prepared the apparatus used in the lectures. On the same floor are the lavatories and locker room, the former of the most modern type, well tiled and commodious. All the rear portion of the ground floor is taken up by the elementary laboratory with places for eighty students. The accommodation for each one includes a sink, cupboard and drawers for apparatus and self-room for bottles containing the ordinary solutions used in the determination of the more easily handled elements. On the ground floor is the students' entrance to the lecture theatre and an entrance to the balcony of that apartment. There is also an instructor's room, a balance room, a room for water analysis or special research, the students' reading room, the janitor's office, the ladies' room already described, and a waiting room for visitors.

On the first floor is the laboratory for quantitative analysis. Here the advanced students are working; the apartment is as large as the elementary laboratory and will accommodate forty persons at work. Adjoining is a balance room, instructor's room, a lecture room and the electrolytic laboratory. In these days of electricity, electrolysis has become an important study, and it is gratifying to have a special place for the work with all the necessary apparatus of the newest design at hand. There is also a room for the analysis of iron and steel and a large apartment laid out as a museum of chemical products. In the front of the building are the library and Dr. Harrington's rooms. On the second floor are the large qualitative laboratories, with accommodation for sixty men, balance room, Mr. Evans' office and private laboratory, organic chemistry classroom, combustion room, a room for gas analysis, supply rooms and Dr. Walker's office and private laboratory.

The third floor includes an optical room for the study of crystals and rooms devoted to the study of physical chemistry, which department of late has attracted a good deal of attention. Dr. Adams' petrographical laboratory is also situated on this floor and everything necessary for the microscopic study of rock specimens provided. There is also a large museum for economic minerals, a lecture-room for mineralogy and a special room for blow-pipe determinative mineralogy, which we have already described. Here also are the photographic rooms, including two dark rooms on the maze principle, without doors. There are several fine cameras and an enlarging camera included in the outfit. The attic is by no means a rough, unfinished room. It is lofty with walls painted white and an oiled hardwood floor. Here also are the larger store-rooms, the ventilating fans run by an electric motor, and a large still for the production of distilled water; this machine is automatic in action, of large capacity and supplies distilled water to all the laboratories through tin pipes with tinned joints.

The apparatus of the chemistry department consists very largely in a large number of small implements and devices for particular uses, hard to describe to anyone but a chemist. Outside of this class some portions of the equipment are notable. Balances are provided in generous numbers in the balance rooms adjoining each of the laboratories. The more delicate of these enclosed in glass cases to prevent vibrations caused by currents of air, weigh accurately down to the tenths of a milligramme. The equipment for research in the department of physical chemistry is very complete, particularly such apparatus as is required for the chemical determination of molecular weights. The quantity of material used in lecture illustration is already very large, but further large shipments are now on their way from Europe. The photographic equipment includes lanterns for projection and a projection microscope, so that views of microscopic objects may be thrown upon the screen before a whole class. The set of platinum dishes and crucibles represents a very large amount of money, a bowl about three inches across costing $150. There are several hot-air motors in the laboratories, and automatic devices for many purposes, such as maintaining a bath of uniform temperature for a year without any attention whatever. In every laboratory there are pipes connected with the large vacuum pump, so that vacuum is easily obtainable in a very short time. A perfect telephone system throughout every part of the building saves a great deal of time.

METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports of interest to the metal trades during November, 1897 and 1898, and the eleven months ending November, 1897 and 1898:—

	Month of November.		Eleven months ending November.	
	1897.	1898.	1897.	1898.
Hardware	£5,224	£2,126	£63,817	£24.168
Cutlery	..	4,111	..	49,525
Pig iron	2,724	1,401	9,209	11,280
Bar, etc.	751	1.506	8,629	11,662
Railroad	11	64	45,789	25,218
Hoops, sheets, etc	6,562	10,847	77.823	63,229
Galvanized sheets	3,620	9,981	52,606	65,267
Tin plates	54.450	35,094	217 421	158.976
Cast, wrought, etc., iron	3,090	3,241	31,979	31,894
Old (for re-manufacture)	1,201	..	7,684	3,574
Steel	4,455	3,681	51,956	47,111
Lead	3,451	3,851	27,401	35,876
Tin, unwrought	2,386	1,862	17,369	17,269
Alkali	8,390	6,397	43,239	48,872
Cement	1,306	1,620	19,797	25,382

Industrial Notes.

Cranbrook, B.C., is to have a system of waterworks.

Orillia is to have a new high school to cost about $9,000.

The Aylmer Iron Works have built an extension to their foundry.

Hospital extension is contemplated in Brantford, at a cost of $5,000.

Work is to commence at once on the Ymir, B.C., waterworks.

W. A. Kribs, M.L.A. proposes to start a box factory at Hespeler, Ont.

H. & F. Giddings & Co., Granby, Que., have put in a large Leonard boiler.

M. Beatty & Sons, Welland, Ont., are now running their works by natural gas.

Merritton, Ont., has passed a by-law applying $6,000 to waterworks extension.

The new pulp mill at Mispec, N.B., will be ready for operation next March or April.

The Sydenham Glass Co., of Wallaceburg, Ont., has begun to manufacture flint glass.

A. W. Law is taking charge of the Facer Car Wheel Works, Perth, Ont.—Perth Expositor.

Adams, Burns & Co., of Bathurst, N.B., are looking into the prospects of a pulp mill there.

A new steel canal bridge, the full width of the street, will be built on Maria street, Ottawa.

Jno. Bertram & Sons, Dundas, Ont., are shipping largely to European markets this winter.

T. H. DeCew, Essex, Ont., is about to establish a large stave factory at Fenelon Falls, Ont.

The ratepayers of Belleville have passed the by-law to bonus a carpet factory and rolling mill.

The Stayner, Ont., waterworks by-law has passed. The system is estimated to cost $24,000.

The Ottawa Steel Range Company, Ottawa, has offered to compromise at 50 cents on the dollar.

Dowling & Ottewell, Clover Bar, contemplate erecting a 100 barrel flour mill at Edmonton, Alta.

A canning establishment is proposed at Sussex, N.B., as a branch of the Woodstock, N.B., canning factory.

It is proposed at London to build a $75,000 breakwater to prevent flooding in the western part of the city.

The Imperial Oil Co. has bought out the Bushnell Co.'s refineries at Sarnia and will carry on its business.

A by-law to raise $12,000 to construct main sewers in Pembroke was carried January 1st by a majority of 27.

A system of waterworks is to be put in Cascade City, B.C.

Secord Bros., machinists, are starting business in Winnipeg.

A new summer hotel to cost $40,000 is in contemplation at Danville, Que.; the land around the hotel is to be laid out as a park.

A large number of local companies are being organized in Ontario to manufacture peat fuel on the system recently patented.

A number of Canadian furniture manufacturers have orders from British houses and from firms in South Africa, Australia and India.

The foundry belonging to the estate of John Ledingham, St. John's Nfld., has been sold to Terra Nova Engine & Boiler Works, Limited.

The Sawyer-Massey Co. has decided to remain in Hamilton, and contemplates extending its agricultural implement works in the spring.

The Yule and Tate estates want $50,000 for the bridge over the Richelieu river at Chambly, Que., which after 50 years has reverted to the crown.

Rider & Kitchener, veneer and excelsior manufacturers, Brampton, Ont., are negotiating, with a view of establishing their plant in Lindsay, Ont.

The Nova Scotia Carriage Co. has ordered a 50-h.p. engine and boiler from the Robb Engineering Co., for the new factory it is building at Kentville, N.S.

The Carborundum Company are just finishing an addition to their Canadian branch, and it is expected will be calling for more power in the near future.

The Rand Drill Co. has accepted the $15,000 bonus offered by Sherbrooke, Que., and will remain in that town, and will erect large works in the early spring.

The Londonderry Iron Co. has gone into liquidation, and met its creditors January 5th. The order for liquidation was granted on petition of John L. Reay.

The representative of a woolen company has been in Brantford looking at the old Wincey mill as the possible site of a new woolen mill or knitting factory.

The Aptees Collapsible Box & Veneer Co., West River, Albert Co., N.B., have bought a 125-h.p. boiler from the Robb Engineering Co., Ltd., Amherst, N.S.

Judge Morgan, Toronto, has recently given a number of decisions against users of gas lamps, which has been decided as infringing the Auer Light Co.'s patents.

The Berlin Brush Works, recently burnt out, is being reorganized and located at Waterloo, Ont. The factory starts up this month with fifteen hands to begin on,

Grantham, Fisher & Co., Ltd., Yarmouth, N.S., are applying for incorporation to manufacture cordage. W. H. Avis, formerly of Toronto, is one of the promoters.

An evidence of the prosperity of Toronto is the subscription of $250,000 for the establishment of another paving brick company near Mimico. J. W. McBride is manager.

St. Catharines will offer inducements to the Toronto Rubber Co. to rebuild in that city the works recently destroyed at Port Dalhousie. Merritton is also after the works.

The power plant for the new butter factory at Cowansville, Que., has arrived, and is now being installed. The plant was furnished by the Jenckes Machine Co., Sherbrooke, Que.

Stratford will soon vote on a by-law granting a loan of $30,000 to the Whyte Pork Packing Co., a concern that promises to spend $50,000 in the erection of buildings, machinery, etc.

Alphonse Pallascio, dealer in hardware and house furnishings, Montreal, has assigned and filed his statement. The list of creditors includes 135 names and the total liabilities amount to $228,000.

The St. John's, Nfld. Gas Light Co., is remodeling its plant and doubling its capacity, which in the spring will be 125,000 cubic feet. Gas for fuel and power is now supplied there at $1.50 per thousand.

The Standard Drain Pipe Co., St. Johns, Que., has lately improved its facilities for handling raw stock by the installation of a Dake Hoisting Engine, from the Jenckes Machine Co., Sherbrooke, Que.

The John Gillies Estate Co., Carleton Place, Ont., has secured the patent on a new gas and gasoline engine for steam launches—a simple and economical power—and will put them on the market at once.

The town council of St. Lambert, Que., have considerable difficulty in deciding whether the waterworks have been installed according to contract. McConnell & Marion have reported against the work as done.

L. L. Sheldon, of Aylmer, Ont. has disposed of his interest in the Aylmer Iron Works to E. C Jenkins, Springfield. The new firm will therefore consist of Henry Sheldon and Mr. Jenkins, who will at once add a lot of new and improved machinery.

The De Laval Manufacturing Company, with capital stock of $10,000, is asking for incorporation in Quebec for general trade in centrifugal machinery and other purposes. The applicants are: J. S. Clunie, W. Carey, C. W. Schnare, M. J. F. Quinn, Montreal, and F. J. Arend, New York.

A by-law to authorize the issue of debentures for the sum of $110,000 for the construction of waterworks and sewerage systems for the Town of Oshawa, is to be submitted to the ratepayers to vote upon on January 21.

An American syndicate has bought five acres of ground at Thorold, on which it is proposed to erect works for the manufacture of caustic soda and bleaching powder. It is reported the capacity of the works will be 100 tons per day.

The last car-load of old plates, bolts, etc., from the old Victoria tubular bridge was shipped to Hamilton, Ont., Dec. 15th, consigned to the Ontario foundry of that city. This completes a shipment of 477 car loads of this material.

The large boiler for the new mills of the Frontenac Milling Co., Kingston, have arrived from Sherbrooke, Que., and are being set in. The compound condensing engine is expected shortly, and the whole plant it is expected will be in operation early in 1899.

The Massachusetts Institute of Technology, Boston, has during the past year received gifts amounting to almost one million dollars. A travelling fellowship in Architectural Department has been established. There were 1,171 students in attendance during the year.

Sewrey's foundry, Barrie, Ont., which has been practically idle nearly three years, and has a capacity and machinery for eighty workmen, has passed into the possession of Dyment & Butterfield, who will manufacture engines, boilers, mill machinery, ploughs, and other farm implements.

George McAvity and G. G. Ruel, St. John; J. D. Chipman, St. Stephen; Hon. F. P. Thompson, Fredericton and Joshua Peters, of Moncton, are seeking incorporation as the New Brunswick Cold Storage Company, Limited; capital, $250,000; Rothesay is to be the chief place of business.

The Canada Screw Co., located at Hamilton, which was owned by the American Screw Co., of Providence, R.I., has been disposed of to a Canadian company, with C. A. Birge, the present manager, at the head. The concern has a capital stock of $5,000,000 and the business will be carried on as usual.

The Northey Mnfg. Co. has recently shipped a hydraulic mining pump, weighing 40,000 lbs., and having a capacity of 2,000 gallons per minute, to Ashcroft, B.C. It has also built a triplex power pump of 5,000,000 gallons capacity for the Montreal Water and Power Company. This is the largest pump of its kind ever made in America, and will be operated by a 450-h.p. motor.

A number of men are busy at the Standard Chemical Co.'s works, where Mr. Chute is rushing forward the completion of the new bench of retorts. There are fifty of these huge retorts in a row. Mr. Butler is arranging for laying down the railway tracks through the new sheds, and the old works have been practically rebuilt.—Deseronto Tribune.

Arnprior, Ont., has offered a Cleveland, Ohio, firm, manufacturers of tacks, nails, bolts and files, which are looking for some suitable place to locate outside of Cleveland, a free site, consisting of four acres lying south of the C.P.R. track and having as one of their boundaries the Madawaska river. An exemption from taxation would also probably be given.

Prof. Ruttan and Prof. Nicholson, of McGill University, Montreal, are making tests in connection with Emerson's process for the extraction of different products from sawdust and for the manufacture of calcium carbide therefrom. Prof. Ruttan is stated to have said that the machine is a success, but the products are new, and consequently it will take some time before he will be able to report as to their commercial value.

R. H. Buchanan & Co., Montreal, who represent the Blake & Knowles steam pump for Canada, have received the contract for the fire protection plant for the Protestant Insane Asylum at Verdun, Que. They have supplied the Montreal Rolling Mills Co. with one hydraulic steam pump; Linton & Co., boot and shoe manufacturers, a boiler feeder; a pumping plant to the St. Vincent de Paul Penitentiary. The suction pipe, 2,000 feet long, for the Merchants' Mnfg. Co., St. Henry, Que., was completed on the 14th Dec. Buchanan & Co. have put in the longest suction pipes in Canada and all are giving thorough satisfaction.

The Dominion Radiator Company, Dufferin street, Toronto, is selling its wares in all parts of the world. Among the notable buildings and institutions which are being warmed by radiators made by the Dominion Company are the Palace of Justice at Praetoria, South Africa; the Park Hospital at Lewisham, near London, England, an institution composed of 29 separate buildings and covering 56 acres; the Edinburgh County Hospital and the Imperial Board of Trade building, Berlin. The orders for some of these institutions were obtained in the face of the keenest United States competition. Royalty owes its comforts during cold weather to Canadian radiators in some instances at least, for the Dominion Company supplied the entire heating apparatus for the German Emperor's palace at Berlin, and for King Oscar's at Stockholm. The Old Parliament Buildings at Dublin were also entirely equipped with heating apparatus by this company.

The exploring party under Alex. Niven, P.L.S., left Haileybury, on Lake Temiscamingue, on 23rd of May last, to complete the survey of the boundary between Nipissing and Algoma. In 1896 the line was run north from the northeast angle of the township of Lumsden, for a distance of 120 miles. During the past summer the boundary was further surveyed for a distance of 180 miles from the point where operations ceased two years ago to a point four miles north of Moose river, on James' Bay. Having successfully accomplished the work allotted to them, the party started on the 10th of October on the return journey by way of the Abitibi river and Abitibi lake and Lake Temiscamingue. Had the weather proved favorable, the journey, which is about 425 miles, would have been accomplished in six weeks. But severe weather set in earlier than was anticipated, and the water stretches began to freeze, rendering canoeing a difficult matter at first, and afterwards an impossibility. The consequence was that the explorers did not reach Bay de Pierre, on Lake Temiscamingue, which was practically the end of their journey until the 25th November, or a month and fourteen days after leaving Moose Factory.

Electric Flashes.

Prescott, Ont., has passed a by-law to raise $15,000 for a municipal electric light plant.

Vancouver, B.C., wishes to purchase the electric railway. It is stated the report is denied, however.

The Barrie Electric Light Co. difficulty has been settled by an agreement by which the town will acquire the works for $22,501.

The Packard Electric Co., Ltd., St. Catharines, Ont, has sent out a handsomely printed New Year's greeting to its friends and customers.

Thomas E. Hillman, engineer, Hamilton, has been instructed to survey two lines for an electric railway from that city to Guelph and Berlin.

The municipality of Chatham, Ont., intends to install a new dynamo for arc lighting. It runs the arc lights and the Chatham Gas Co. the incandescent.

The Robb Engineering Co., of Amherst, N.S., has received an order from New York parties for two 300-h.p. engines for an electric railway in Australia.

Wm. Stuart, Ottawa, has been awarded the contract for building the electric power house on the Soulanges canal. The amount is in the vicinity of $50,000.

It is stated that electrical iron smelting is being successfully carried on at Sault Ste. Marie. F. H. Clergue states that as yet there are no exact details available for publication.

By-laws relating to the establishment of electric lighting plants at Forest and at St. Thomas, Ont., have been defeated; Thorold has passed one to raise $5,000 to extend its plant.

The electric lighting plant recently sold to the corporation of the town of Campbellton, was started up for Christmas lighting. The driving power is water, and the electrical apparatus is of the Royal Electric Company's S.K.C. two-phase type for arc and incandescent lighting and power.

The Trail smelter is now run by power furnished by the West Kootenay Power & Light Co. from Bonnington Falls.

The large elevator of the J. G. King Company, of Port Arthur, Ont., is being lighted throughout by electricity, the entire plant being furnished by the Royal Electric Company of Montreal.

The Yarmouth Times says the Street Railway Company of that town intend making quite extensive improvements in their cars. New motors of the latest type have been ordered and will probably arrive shortly.

The Gurney-Tilden Co., Hamilton, Ont., is now operating its entire works by electric power. It has installed two 20-h.p., and one 30-h.p. S.K.C. two-phase motors, and gets the current from the Cataract Power Co.

The 60-k.w., S.K.C. generator of the Dundas Electric Co., has been placed in position. They expect to have their water power in operation in a few days, and will begin the lighting of the city by the 15th of January.

G. H. Carroll, J. F. Boultbee, A. N. Parney, E.E., Paris, Ont., and W. J. Clark, T. McLaughlin, Toronto, have been incorporated as the Grand River Electrical Power Co., Ltd.; capital, $95,000; chief place of business, Paris, Ont.

E. A. C. Pew is negotiating with capitalists to start manufactures at Jordan, and thus afford a market for the power to be developed by the raceway from the Welland river, which enterprise he has been promoting for some time past.

The Kingston News urges the municipalization of the gas and electric works of the city, and the appointment of a commission to find out what water powers are available within range of the city for increasing the city's electric power.

M. Letheule, an electrical engineer of Paris, France, was in Quebec recently. He was sent by the French Government to visit Canada and examine and report for French capitalists on the application of electricity for industrial purposes.

The Dominion Bridge Company, Montreal, has just completed the installation of an arc lighting system in its large works at Lachine, Que. The dynamo and arc lamps were manufactured by the W. A. Johnson Electric Company, Toronto.

The Cannington Echo reports that the newly-formed Victoria Telephone Co. will apply for incorporation and erect poles in the spring. The first lines will run between Beaverton and Argyle, Cannington and Sutton, and from Oakwood to Lindsay.

The flour mill of Lake & Bailey, Hamilton, is being driven by a 75-h.p. S.K.C. synchronous motor, which has been in operation two weeks, and is giving perfect satisfaction. They have shut down their steam plant and hope they will not have to go back to it again.

The W. A. Johnson Electric Company is installing an alternating plant for the corporation of Acton, which includes 55 street lamps, and all wiring for the town. The generator will be one of the inductor type alternators, which are meeting with much success.

The B. Greening Wire Works, Hamilton, have installed in their works a 50-h.p. S.K.C. induction motor. This motor is driving on to the same shafting as their engine, and is working very satisfactorily. They intend to replace their steam power entirely with electric motors.

The proposal to extend the Scarboro Electric Railway to Whitby and Oshawa with a connection to the C.P.R. at Myrtle is again being agitated. The extension to Oshawa and Whitby was provided for in the original charter. The line is controlled by the Toronto Railway Co.

The Gendron Manufacturing Company has recently installed a direct connected 600 light generator for lighting its factory. The order was placed with the W. A. Johnson Electric Company for both the generator and the wiring of factory. A 10x10 engine manufactured by the Goldie & McCulloch Co., of Galt, Ont., will be used.

Hull, Que., will operate and control a civic lighting plant, the by-law authorizing the City Council to raise debentures for the plant having been carried. The work of putting up the poles and wires will be commenced immediately. The Ottawa Electric Light Co. will probably supply the current for lighting until the town has its own dynamos ready for operation.

Wm. McKenzie, Fred. Nicholls and other Canadian capitalists have been negotiating for the street railway franchise in Havana, Cuba.

Galt, Ont., voted down the by-law devoting $67,750 to the purchase of the gas and electric light plants from the private company operating them.

The Eagle Knitting Co., Hamilton, Ont., has installed in its factory a 30-h.p. S.K.C. two-phase induction motor, which drives their knitting machinery, and has replaced their steam plant.

The Montreal Street Railway Co. has, it is stated, decided to build all its own cars at its Hochelaga workshops, and will add brass and iron foundries to the present plant. Cars will also be built for the Toronto and other lines.

The directors of the Hamilton, Chedoke and Ancaster Electric Railway have decided to apply for an amended charter to build a line to Brantford, Ont., to change the name to the Hamilton, Ancaster and Brantford Electric Railway Company, and to increase the capital stock from $100,000 to $200,000.

The plant for the town of Norwood, Ont., recently installed by the W. A. Johnson Electric Company, is giving much satisfaction to the purchaser. The machine is of the single-phase inductor alternator type of machines, which the company claims are practically indestructible, and have the excellent advantage of a very low speed.

The Alliston Electric Light Co., Alliston, Ont., is making changes in its lighting station, and has decided on increasing its incandescent light capacity, and for this purpose has placed an order with the Royal Electric Co., for one of its 60 k.w. S.K.C. two-phase machines, from which it will serve both arc and incandescent lights as well as power, which has heretofore been served by two machines.

Beeton, Ont., recently decided to install an electric light plant and are now highly pleased with it. The plant was installed about two months ago, and since then the number of lights have increased to nearly the capacity of their present machine, which is one of the W. A. Johnson Electric Company's inductor type of alternator, which are claimed to be so suitable for a plant where a repair shop is not near by.

The Wallaceburg Electric Light Co., Wallaceburg, Ont., which has been supplying arc lights for the town of Wallaceburg for a number of years, has decided to go into the incandescent lighting business, and has placed an order with the Royal Electric Co., for a 30 k.w. alternator, and 900 light capacity in S.K.C. transformers and material. It expects to have the lights in operation by the first of the new year.

The Hamilton Electric Light & Power Co. is installing in its lighting station two 240 k.w., and one 350 k.w. S.K.C. synchronous motors. These are to drive the shafting from which is operated the arc machines and the motor power service. The current for these motors is to be supplied by the Cataract Power Co. It is expected that the steam plant will be entirely shut down by the first of February. The incandescent light has been furnished from the Cataract Power Co.'s current for the past three months, and has been very satisfactory.

We are advised that since the purchase by the Westinghouse Manufacturing Company, of Pittsburgh, of the Walker Company, the Canadian representatives of the latter company, W. A. Johnson Electric Company, of Toronto, will continue to represent the combined interests of those companies in Western Canada. The advantages of this arrangement are quite plain, as the Westinghouse Company manufactures a most complete line of apparatus for long distance power transmission, including A.C. D.C. generators, rotary transformers, induction and revolving field generators.

In referring to the fire at the Greenshields warehouse on Victoria Square, Montreal, The Witness stated that the fire gave proof of the underground system of the Lachine Rapids Company being superior to overhead mains. The poles carrying the lighting mains of this company were broken and fell to the ground, together with the Street Railway and other companies' wires, which lay in a mass on the ground, but notwithstanding this, the Lachine Rapids Hydraulic & Land Company were enabled to give every customer on their system light long before daylight, owing to the fact that they have an underground system. Before giving their customers light, broken wires and poles had to be replaced.

The Montreal Gazette recently stated that the Graburn and Blancy Canadian patent of the Graburn electrical thawing process has been sold by the inventor, Nelson Graburn, of Montreal, to the Electrical Thawing Syndicate, Ltd., London, Eng., for £7,000, and one-quarter interest in the company. The patent is intended to be used in countries like the Klondyke, where mining is carried on with the ground being frozen to a considerable depth. It provides for specially constructed dynamos and electrodes, the latter being placed against the walls of the shaft, with a space of from five to six feet of ground intervening; so that when the current is turned on, it has to cross the face of this space to complete the circuit and the ground contained therein, forming a resistance to the motion of the electricity, heat is generated and the ground thawed.

The Niagara Falls Power and Electric Company has won in the suit against the Niagara Falls Park Commissioners. The Park Commissioners claimed that the company had forfeited its charter because one clause, which said that by Nov. 1 it should have completed water connection for 25,000 horse-power and have ready for transmission 10,000 developed horse-power, had not been fulfilled. A series of questions were asked the Court of Common Pleas, and to-day the judgment of that court was: (1) That the agreement is not void by reason of the failure of the works by Nov. 1, 1898; (2) the Government or Commissioners may not, by reason of the non-generation of electricity by that date, declare the agreement void; (3) the Government and Commissioners are not relieved from the agreement not to grant any other company the right to take or use the waters of Niagara river.

W. A. Johnson, of the W. A. Johnson Electric Company, reports the recent sale of Westinghouse apparatus to the Metropolitan Railway Company, Toronto, for the extension of the present railway to Lake Simcoe. In the power house at Bond Lake will be installed two 60 cycle three-phase, A.C., D.C., generators, each of about 400 h.p., and a full complement of switchboard apparatus, step up transformers, lightning protection, etc., will be provided. The transmission voltage will be 16,500. There will be two rotary transformers, 60 cycles, three-phase, giving 570 volts on direct current side, these will be located in sub-stations about 14 miles from the generating stations, step-down static transformers being provided to reduce the voltage to that suitable for the rotaries. The generator switchboard will consist of eight marble panels, the sub-station switchboards of five marble panels with non-arcing and tank lightning arresters. In addition to the above there will be passenger and freight car equipments, including one quadruple equipment for heavy freight car and double equipments for two light freight cars; two double equipment for ordinary passenger cars and two quadruple equipments for heavy passenger coaches; the motors being used in these will be 38 B 50 h.p. each. The sale includes one 45 ton Baldwin-Westinghouse electric locomotor.

Marine News.

A Government engineer is examining the breakwater at Richibucto. If trade warrants it the entrance to the harbor will be deepened to 19 or 20 feet on the bar.

P. C. Jones, Belleville, Ont., has ordered from the Davis Dry Dock Company, of Kingston, a 16 h.p. fore and aft compound engine for a new steam launch to be completed by April next.

It is proposed to organize a local company at St. John's, Que., to build a steamer of a speed of 15 miles per hour and a capacity for 450 passengers, as an excursion boat on the Richelieu river.

Nagle & Hislop, traders of Fort Resolution and Fort Rae, have purchased the steamer "Sparrow," now in winter quarters at Grand Rapids. They will take her below Smith rapids in the spring and will run her from Smith rapids to the Arctic Ocean. This is the best built of all the steamers put on the Athabasca last summer.—Edmonton Bulletin.

It is said that Carrier, Laine & Co., the well-known Levis foundry and machine men, have undertaken to supply Captain Bernier, the would-be discoverer of the North Pole, gratis with the aluminum boats needed.

The Calvin Company launched at Garden Island recently the largest steamer ever built thereon. She is named the "India," and is intended for the timber carrying trade between western lake ports and Garden Island.

At a meeting of the directors of the Richelieu & Ontario Navigation Co. it was decided to add another boat to the present Saguenay fleet, and that the steamer "Saguenay" should be renovated before the opening of navigation. She will be lighted by electricity, and, when finished, be equal both in speed and accommodation to any of the company's other boats. A boat will be run, commencing at the opening of navigation, every day, including Sunday. This decision on the part of the board will be received with general satisfaction, as it will permit business men who have their families staying at Murray Bay to spend Sunday with their families, and return to business on Monday. A hotel at Murray Bay, to cost $30,000 and accommodate 300 guests is in contemplation by the company. The new steamer "Toronto" has had her trial trip, and will be put on the Lake Ontario route in the spring.

Personal.

Jno. Fisher, president, Small & Fisher Co., Ltd., iron founders, Woodstock, N.B., is dead.

E. T. Wilkie, C.E., Carleton Place, Ont., was married recently to Miss K. Snedden, Almonte.

Alex. Bowie, Ottawa, who was well-known among the early navigators of the Ottawa river, died January 1st.

David Higgins, an employee of the St. Lawrence Foundry, Toronto, fell into a vat of boiling water recently and was fatally burned.

F. C. Armstrong, who went to London last year to take an important position with Dick, Ker & Co., has returned to Canada to be married.

C. H. Mitchell, town engineer, Niagara Falls, Ont., has returned from Potsdam, N.Y., where he has been engaged on extensive public works now going on in that city.

C. E. Moore, son of C. P. Moore, proprietor of the R. Spence & Co. file works, Hamilton Ont., died very suddenly at Ottawa, recently. He travelled for his father's firm.

Hugh Muckleston, a graduate of the Royal Military College, Kingston, Ont., now in Victoria, has been ordered by the Government to go to Alaska on a survey expedition.

On Christmas Eve Raymond Smith, superintendent of the Sherbrooke, Que., street railway, was presented by the employees of the company with a fine gold ring as a token of esteem.

John H. Campbell, mining engineer, who has of late been working with the Virginia Gold Mining and Milling Company, of Arizona, has been engaged as mining engineer and superintendent of the Smuggler mine.

P. F. Hodgson, late chief signal engineer of the Grand Trunk, sailed on Jan. 8 for London on the Parisian from Halifax, and will look after the management of the Saxby & Farmer signal works at London, which appointment he received a month ago.

A. G. Allison, chief despatcher of the Grand Trunk at Toronto; has been dismissed on account of a recent accident to a freight train at Belleville. Mr. Allison has been forty years in the service, and is said to have been the oldest railway operator in America.

J. E. Muhlfeld, general foreman, motive power, machine and car departments of the Wabash, stationed at St. Thomas, Ont., has been appointed master mechanic of the western division of the Wabash, with headquarters at Fort Gratiot. He will be succeeded by F. Whitley, late of the Illinois Central.

Dr. S. A. Mitchell, son of John C. Mitchell, contractor, of Kingston, has been appointed research assistant at the Yerkes Observatory in connection with Chicago University. He is a graduate of Queen's College, where he secured the degree of M.A.; he also won the degree of Ph.D. at Johns Hopkins University, Baltimore.

The Quebec Telegraph says: Chevalier Chas. Baillairge, F.R.S.C., addressed a letter to Mayor Parent recently, tendering his resignation of the post which he has held so long as city engineer. Mr. Baillairge, who is 70 years old, and whose services to the city have merited the rest which he is now seeking, is the first city engineer, having been appointed to that post some thirty years ago under the mayoralty of Hon. Jos. Cauchon, subsequently Lieut.-Governor of Manitoba, previous to which he had held the position of city surveyor, succeeding Mr. Hamel.

Railway Matters.

The new Union station at Ottawa will cost about $130,000.

A company will, at the next session of Parliament seek incorporation with power to acquire and operate the Niagara Central Railway, and to extend it to Hamilton, Toronto, the Niagara River and Lake Ontario.

A handsomely illuminated address was last month presented to Charles M. Hays, general manager of the Grand Trunk, by the Brotherhood of Locomotive Firemen of America, in acknowledgement of courtesies received in connection with the last annual convention.

Orders have been placed with the Nova Scotia Steel Co. for 5,000 tons of steel rails for the I.C.R., weighing 80 pounds to the yard, which is 13 pounds heavier than that generally in use on the I.C.R.—New Glasgow Bulletin.

Jas. Hobson, the chief engineer of the Grand Trunk Railway, who was in charge of the reconstruction of the Victoria bridge, has received great praise for the eminent skill displayed in the manner in which the work was carried out under his direction. The fact that during the progress of the work, including the removal of the great tube, there was no delay of the business of the Grand Trunk, and that the trains passed over the bridge as usual, on schedule time, has been selected for special admiration, which has been expressed in the British engineering journals and elsewhere. Sir Charles Rivers-Wilson has recently, in England, drawn attention to this splendid piece of work, at the same time indicating that English engineering was behind so far as similar work and problems were concerned.

J. A. Macdonnell, chief engineer of the Public Works Department of Manitoba, gives the following summary of railway extensions during the past year, and the proposed extensions of 1899: "The railroad mileage constructed this year is the Dauphin extension from Sifton, 55 miles, the Southeastern to Marchand, 46 miles, Rockwood extension on Stonewall branch, 20 miles, the Pipestone extension to the boundary of the province, 3 miles of track, and 17 miles of grading, Belmont-Hartney extension, 46½ miles, switch connection between N.P. and C.P.R., ¼ mile; making in all a total of 178¾ miles. The probable extensions of next year are: The C.P.R. Pipestone branch from the end of track at present, 50 miles to the Moose Mountains, the continuation from Toulon, the end of the present Rockwood branch to Gimli, on Lake Winnipeg, a distance approximately of 20 miles, extension of the Southwestern to the Lake of the Woods or Rainy river—if the former be chosen, 75 miles; if it be decided to go around the southwest corner of the Lake of the Woods to Rainy River, the length of construction will be in the neighborhood of 125 miles. If the season is favorable about 100 additional miles will be constructed on the Dauphin line, carrying it to the northern limit of the province, and beyond. The construction of the Belmont branch will be continued to Hartney or a point on the Souris river in that vicinity. Other extensions are also being considered by the Northern Pacific, the particular location of which it is not at present possible to indicate."

In an interview with a local journalist recently, J. M. Shanley, C.E., who has charge of the construction of the Atlantic and Lake Superior Railway along the Baie des Chaleurs route, is reported as giving some interesting details regarding the work now being done at the harbor of Paspebiac. The large wharf which is being built at this point by Heney and Smith, of Ottawa, will be, when completed, 1,800 feet in length and 80 feet in width, and will accommodate two steamships of the largest tonnage, besides smaller craft further landward. A large elevator, to have a capacity of 1,000,000 bushels, will be situated near the end of the wharf; this has already been contracted for. The steamers will be protected from all winds while lying in the harbor, where, according to Mr. Shanley, the anchorage is of the best possible kind. Mr. Shanley also stated that what was known as the Barachois Lagoons would be reclaimed, a work which could be done with but little trouble or expense, and the land in question used as a shunting ground. Six hundred men are at work blasting the cliff which lies between New Carlisle and Paspebiac, and half of this work has already been accomplished. The railway, Mr. Shanley said, was in good condition and the stone work for the new bridge over the Big Bonaventure river was completed and awaiting the superstructure.

Mining Matters.

The Iron Mask Mining Co., Rossland, B.C., has ordered a ten-drill compressor plant.

Gold in Guysborough County is looking up. The mines at Goldenville are working all the time.

A company of Lunenburg, N.S., and Mahone Bay capitalists have been formed to work the rich gold find which has been made at New Cornwall.

A school of mining instruction has been opened at Kamloops, B.C., by A. J. Colquhoun, M.E., who is known in connection with the British Columbia School of Mines. The classes were started January 9th.

J. D. Chipman, who represents the English capitalists now in control of the St. Stephen, N.B., nickel properties, has received a cable message directing him to send forward twenty tons of the ore.—Fredericton Reporter.

The Glencoe Oil and Gas Company, of Glencoe, with a capital of $20,000, has been incorporated, the following being the provisional directors: Geo. Parrott, W. J. Small, S. H. Small, R. J. R. Aldred, A. E. Aldred and Geo. Hay.

The old iron mines at Woodstock, N.B., have been purchased by a Chicago firm, and a tramway will be built to the ore beds. As the ore is well suited for the manufacture of high grade steel, the industry may be a large and permanent one.

L. Sherk, Son & Co., of Hamilton, who are operating the Wallbridge Hematite mine, Hastings County, have contracted to supply 50 tons per day to the Hamilton smelter. The ore is said to be the best shipped to Hamilton, averaging as high as 62 per cent.

B. Kelly, of Ottawa, claims to have made a valuable discovery of gold-bearing quartz in the county of Lanark, about three miles from the Kingston and Pembroke railway. He has purchased the property. Assays taken, he says, far exceed anything known in Eastern Ontario.

The Dominion Coal Company is sending one of its most experienced engine drivers to South Africa to practically demonstrate that Cape Breton coal is excellent fuel for steam purposes. It may be remembered an experimental shipment was made there early in the autumn. There is said to be a large market for steam coal in Cape Colony.

The value of ore produced by the Rossland mines during the year just ended, reached the enormous aggregate total of $2,804,758.12. The shipments were 116,697 tons; for the year ending December 31, 1897, the shipments were 68,000 tons and the value of the ore mined was $2,100,000. In a single year the shipments from the mines were almost doubled, while the value of the output increased $700,000 or 33 per cent. The year has been remarkable for the influx of foreign capital, which absorbed some of the better Rossland properties. First in size comes the British American Corporation, with investments of nearly $5,000,000.

An innovation in treating free milling ore will, it is said, be made by the Oro Fino Mines Company, which has property at Fairview. After careful examination and reports received from some well known mining engineers, the board of directors has decided to put in one of the new Parks amalgamators. This will supersede the old plate method of saving and collecting the gold, and at the same time afford greater protection against stealing the amalgam. It is absolutely impossible to get at the amalgam, as one man, the superintendent, controls the whole machine. The Wm. Hamilton Company, of Peterboro, Ont., and the Parks claim to have effected a combination that will revolutionize the treatment of free milling ores.

Madoc village is the centre of active mining operations. The Review says: The Cordova mine in Belmont, ten miles northwest of Marmora, is being worked under option by a wealthy English syndicate. The mine was formerly owned Carscallen and Lingham, and latterly by A. W. Carsc M.P., of Marmora. The mill of the Canadian Goldfields Company at Deloro will be running in a short time. Work is being prosecuted steadily at D. E. K. Stewart's "Diamond Mine," about six miles east of Madoc. A few weeks ago Meyer Brothers, representing wealthy Belgian capitalists, interested themselves in this mine, and under the direction of Leopold Meyer, mining engineer, of Brussels, Belgium, a three compartment shaft has been put in, building erected for boiler house, and machinery installed for hoisting the ore working steam drills, etc., and it is expected work will be pushed vigorously during the winter.

DISPUTED POINTS IN CONNECTION WITH THE CONSTRUCTION AND MAINTENANCE OF MACADAMIZED ROADS.

BY H. IRWIN, M. CAN. SOC. C. E.

The present paper was written in October, 1893, and was originally intended to be used as a private record of the opinions expressed by several members of the American Society of Civil Engineers during the course of a discussion on the subject before us, which may be found in the transactions of that Society for December, 1892, and February, 1893. The purpose of the paper is to compare the opinions of the engineers who took part in the discussion above alluded to, not so much with a view of bringing forward anything new, which would be almost impossible, but in order to ascertain how far the diverse opinions might be reconciled or accounted for by difference in the local conditions.

The principal points discussed are arranged under the following heads, viz.: 1. Grades. 2. Drainage. 3. Transverse section. 4. The necessity for using the Telford foundation and its construction. 5. The construction of macadamized roads without the Telford foundation. 6. Quality of stone, and the size of the macadam. 7. Blinding material and its usefulness. 8. Rolling—Whether by horse or steam rollers. 9. Repairs or maintenance. The writer proposes to take these up in the order given.

First, Grades.—Mr. Owens states that any departure from an ideal grade of 1 per cent. is to a certain extent to be resisted, and that the minimum grade should never be less than ½ per cent. in order to secure proper longitudinal drainage; and that the maximum grade for ordinary country and general travel should be 4 per cent., which is the limit of an ordinary trotting gait. F. Crowell differs from Mr. Owen as to 1 per cent. being the ideal grade—and states that, in his opinion, if a uniform grade of 1 per cent. can be secured, without undue expense, it is preferable not to exceed it, but that where the road is undulating, with frequent reversions of grade, the horse will do equally well or even better with grades of 2 per cent. He also states that it is well known that horses as a rule travel better on a slightly hilly country than on a dead level. The other members who

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*Extracted from a paper read before the Canadian Society of Civil Engineers joined in the discussion do not appear to have touched on this branch of the subject. The writer would venture to remark that both maximum and minimum grades might be made to suit the class of vehicles most likely to make the greatest use of the road to be constructed, and that the question of cost would have to be considered. In farming districts, where the large majority of the vehicles carry heavy loads and do not go faster than a walk, the maximum grade might well be raised to 5 per cent. and the extra cost of 4 per cent. grades either saved altogether or expended on the road surface. As to the minimum grade, water will flow so freely along a water-table or gutter with a fall of ½ per cent., that a similar grade might well be taken as minimum for long uniform stretches of road, short pieces of level being permitted to break grades or at summits. The fact that horses seem to travel better on undulating roads, where the grades are not over 2 per cent., than they would on the level is probably due to change in the muscles used in ascending and descending; this would apply, however, more to heavy than to light traffic, as a trotting horse, going at a good pace, would find a 2 per cent. grade pretty hard, and would probably travel much easier on the level than on an undulating road, especially if allowed to walk a short distance occasionally. The writer would add that he has often heard drivers complain of a long uphill pull, even when the grade was light.

Secondly, Drainage.—Mr. Owen's opinion is that: "It is necessary at all times that proper and complete provision be made for thorough and perfect drainage of the water from the roadway; this, as well as the necessity of under-drainage in certain specified localities, either by pipes or blind drains, admits of no dispute, when the fact is remembered that one dollar spent judiciously in under drainage will save many dollars as a capitalized fund to meet the expense of repairing badly drained sections of the road." Latham Anderson, referring to the rainy and muddy part of the country east of Central Kansas, says that: "Given an earth road skillfully located, properly shaped for surface drainage, and with the roadbed thoroughly under-drained with tile, say, to the depth of at least two feet, all that is necessary to make this a fairly good country road is to cover a strip in the middle, say 14 to 16 feet wide, with six inches of gravel or shale." Mr. Anderson also recommends the excavation of ample ditches, and using the earth thus obtained to raise the sub-grade above the surrounding ground and the construction of drains under the road surface in all clay or tenacious solid. J. E. Cooper states that: "Telford roads put together with loam and light rolling stand because the water, that will surely find its way through the metal, is drained away through the Telford," and that "the macadam roads put together in the same way will go to pieces because sub-drainage is not provided." W. C. Oastler on the other hand states that: "The suggestion that the earth sub-way being flattened instead of being an arc of a circle causes the drainage to be defective or insufficient is not correct in practice; that the stone road above the foundation will, if properly rolled, be practically water tight, and will preserve itself and the foundation against the inroads of water;" and also says "I do not believe it is worth time or money to make elaborate schemes for under-drainage of broken stone roads. Lateral drains, honey-combed foundations and other expenses for so-called drainage are wasteful excess and generally can be omitted." Messrs. Owen, Anderson and Cooper would thus seem to differ materially from Mr. Oastler as to drainage. On closer examination, however, the difference of opinion may be considerably reduced. All are agreed, of course, as to the necessity of surface drainage. With regard to under-drainage, Mr. Owen states that its necessity in certain specified localities, either by pipes or blind drains, admits of no dispute. Mr. Anderson's opinion evidently is that an earth road should be thoroughly under-drained with tile in order that it might be put into fairly good order with six inches of gravel or shale. Mr. Cooper seems to think that the Telford foundation will act as an under-drain, while Mr. Oastler saves himself from being too dogmatic by stating that lateral drains and honey-combed foundations can generally be omitted. Surely Mr. Owen's statement last referred to admits of no dispute, since under-drainage is an absolute necessity where there are springs under the road surface and in wet clayey soils where the side ditches will not drain the centre of the road-bed. Mr. Anderson's opinion as to earth roads might be modified by stating that in open gravelly soils the side ditches, when not too far apart, may be counted on to drain the road-bed. Mr. Cooper's idea that the Telford foundation will act as an under-drain may hold good for a year or two after the road has been constructed, but the writer does not think that it would hold good for any length of time, as he has never yet seen an old foundation dug up in which the spaces between the stones were not completely filled with earthy material, so that it could not possibly act as a drain. Indeed, even when the foundation was quite new, it is almost certain that the water, on passing through it, would soak into the earth below, unless some special provision were made to carry it off at the sides. Mr. Oastler's scheme for avoiding under-drainage altogether by keeping the surface well rolled would also involve constant repairs to prevent water standing in slight hollows, would probably be more expensive in the long run than under-drainage, and could only be carried out in rich districts. The writer's experience, though rather short, so far as actual practice goes, certainly goes to show that less depth of stone is required on a firm, well-drained road-bed. The approximate distance apart at which drains act might be given: In open gravelly soils, drains from three to four feet deep will act from twenty-five to thirty feet on each side; in such soils the side ditches will drain the road-bed perfectly if deep enough. Where the soil is marly loam, drains will act about twelve to fifteen feet on each side, in this case, unless the road surface is kept in good order so as to throw all rain water quickly into the side ditches, and unless the road-bed be originally dry, as on a side hill, or in embankment, a covered drain would be required along the centre. In stiff clay soils French drains can only be counted on for about eight or ten feet on each side, in which case, if the sub-soil be wet, V drains running from the centre of the road-bed diagonally to the sides may be needed. In making drains, it is well to remember that water will not flow through soil so nearly on a level as it will in an open channel. Drains, therefore, will only dry wedge-shaped sections of ground, and the denser the soil the steeper will be the wedge. The subject of drainage might be closed by quoting Mr. Calvin Tomkins' remarks, viz.: "It is possible by making the road-bed sufficiently thick to ignore a wet bottom, but is cheaper to arrange for a dry base and place a thinner road on it. Drainage is of the first importance, but the cost of drains can be greatly modified by making the surface of the road as nearly water-tight as possible."

Thirdly.—The transverse section of the road-bed and of the foundation. Mr. Owen states that "it is agreed on all sides that the road-bed should be graded to a surface uniform with the finished roadway," and that his practice is to roll the road-bed when no foundation is used, but not to roll it previous to laying a Telford foundation, which he brings to a uniform surface by scooping out the earth below the deeper stones. Mr. Oastler does not agree with Mr. Owen as to grading the road-bed to a surface uniform with the finished road, and prefers to grade it level across; firstly, because it is cheaper, and, secondly, because it admits of using stones of different thickness, the larger stones being placed in the centre. Mr. Oastler also prefers to compact the road-bed by rolling, and does not agree with Mr. Owen's plan of laying the foundation, even by scooping out earth under the stones, as he does not think it necessary that the surface of the foundation should be quite even. Mr. Callanan stated that his practice was to grade the road-bed to a surface uniform with the finished roadway securing good lateral drainage. Thomas Codrington, formerly General Superintendent of Roads in South Wales, after stating that, since timber hauling and other heavy traffic generally takes the sides of a road, gives it as his opinion that it is usually better to form the road-bed with its surface either nearly or altogether parallel to the finished surfaces so as to have a uniform or almost uniform thickness of metalling. Mr. Codrington also states that this method of formation is attended with the advantage that a dry formation surface is prepared for the road materials.

The writer thinks, therefore, that it might be fairly concluded that where there is likely to be heavy traffic extending over the entire width of the road, the road-bed should be graded either exactly, or almost, parallel to the finished surface, and that this method of grading the road-bed will help to keep it dry during construction, but that it cannot be counted on for drainage purposes for any great time after the road has been finished; but that, in the case of roads for lighter traffic, which should of necessity be cheaper, the road-bed might be made flat, and the crowning of the finished surface obtained by making both the foundation and the macadam thinner towards the sides. As for the completed surface, in the district of which the writer had charge in Ireland, the usual rule was to raise the centre above the sides at the rate of one inch per yard of width from the centre to the side, the slope being steeper at the sides than in the centre. Mr. Owen states that for a sixteen-foot roadway, an average crowning of four inches is desirable, which is at the rate of one inch in two feet from the centre to side, or a grade of one in twenty-four. The other members who took part in the discussion did not question the statement. Mr. Codrington's opinion is that the fall from the centre to the sides need not be more than six inches on a thirty-foot road, or one in thirty from centre to side, and should never exceed nine inches or one in twenty; and that for a road eighteen or twenty feet wide three or four inches, or from one in thirty-six to one in thirty is enough. He also remarks that, if the surface be neglected and allowed to wear into ruts, no amount of convexity will clear the surface of water. This latter statement can be fully endorsed by the writer, who saw a gravel road last winter, about fourteen feet wide, in the centre of a sixty-six foot road allowance, and raised about two feet above the level of the water tables at the edges of the sidewalks, the water tables being quite dry, and yet the roadway, which was badly rutted, was full of water, and amost impassable. Had this road been well harrowed and rolled, it might have been kept in good condition. As there was no discussion on this subject, it might be taken for granted that on the level, or on easy grades, a fall of from one in thirty to one in thirty-six is sufficient, and that on hills the slope from the centre to the sides might be from one in twenty to one in thirty, and that it is useless to try to make higher crowning take the place of an even surface for transverse drainage.

(To be continued).

—"The G. A. Robertson" catch basin and tap, described in our November issue, is already receiving substantial recognition of its merits, the Montreal Pipe Foundry Co. having had an order from the Corporation of Westmount, Que., for 50. which are now in position, and giving complete satisfaction.

—Owing to the increased demand in Canada for the Norton Ball-Bearing Jacks, A. O. Norton will enlarge his plant at Coaticook, Que., and equip it with special machinery. Export business will also be handled from this point, shipments having recently been made to Japan, South America, Hawaiian Islands and New Zealand.

—This primitive conveyance seems rather to mock the improvements of the age. A horse railroad, about a mile in length, accommodates the residents of a suburb of San Francisco. The grade is about 3½ per cent. A horse draws the car and passengers uphill, the car descends by its own gravity, and then carries the horse on the rear platform of the car. The ascent is made at the rate of 3½ miles an hour, the descent is at the average rate of 15 miles an hour.

—The Hamilton, Ont., Blast Furnace Company has decided to install a steel plant in connection with the blast furnace at once, and employment will be given to a large number of skilled workmen. When the blast furnace was proposed, the city passed a by-law granting a bonus of $65,000 and an additional sum of $60,000 was to be granted if the steel works were in operation within a certain time. The latter bonus lapsed, but the company does not intend to ask any further favor from the city.

—George Waring intends going to Quebec to erect and drive into the woods a novel machine for hauling logs on the snow by steam power. The machine is made in Michigan and is to be sent by rail to a station on the I.C.R. east of Levis, where Mr. Waring will put it together and drive it about seventy-five miles to its place of operation in the forest, on the head waters of the St. John river. George Cushing of St. John is the enterprising lumberman who is starting this new method of handling logs in the woods. The weight of the machine is upwards of twenty tons. It is said that several of these engines are operating about Winnipeg and in the western States. This new departure will be watched with interest.—St. John Sun

—It is probable that for the first time in our history the United States will this year be surpassed by Russia as a producer of petroleum. Reducing the totals to the common standand of metric tons, we produced in 1897 a total of 7,708,236 tons, while the quantity reported for Russia was 6,919,000 tons. For the first half of the present year, however, according to Russian official figures quoted by The Chemiker Zeitung, the output was 3,993,300 metric tons, which points to a total for the year approximating 8,000,000 tons. The output of the United States for 1898 will not differ greatly from that of 1897; if anything it will be somewhat less, so that we may expect to fall to the second place.—The Engineering and Mining Journal.

—A burnished finish on the journals of axles for railway carriages and locomotives has given good service, and has been used on many roads for a long time, says The American Engineer. The advantage of it is to smooth the surface of the journal after the finishing cut, and to shorten the period of breaking in. The burnishing is done by three rollers carried on a tool rest and bearing against the journal, considerable pressure being obtained by a screw. The rest is fed along so that the finishing cut and the burnishing are done at the same time. Mr. Atkinson, of the Canadian Pacific, uses the burnisher on piston rods, and intends to use it on valve rods, as well as on journals. He stated, at the recent Master Mechanics' Convention, that it gave the best finish that he knew of for piston rods.

—Although so recently brought to the notice of the South African public, the adoption of acetylene as an illuminant is making steady progress. It is recognized that there is a distinct field open for it in South Africa among the smaller towns, and in the suburban districts of larger towns where paraffin or candles are still the chief illuminant. At the present price of imported carbide, £32 to £36 per ton in Johannesburg, acetylene gas shows no economy over the electric light, but with the cheapening of prime cost and the lowering of freights—and we understand that the German-Australian Co. has now consented to accept it at a slight additional charge over ordinary cargo rates—a reduction in cost may be eventually effected that may lead to its competing even with the electric light. In the ease of the manufacture of calcium carbide being undertaken in South Africa, the reduction in cost which would follow would enable it to successfully compete with all comers.—South African Mining Journal.

—The report of the James' Bay Railway commission, appointed by the city of Toronto, was handed to the City Council at its last meeting for 1898. The commission has embodied in the report not only the information obtained by the expedition sent out to examine the country along the route of the proposed line, but also deals with the question of Toronto's transportation facilities, with special reference to the proposed Collingwood Air line, the harbor improvements, the Sault Ste. Marie and James Bay Railway, and the connection at Scotia with the Parry Sound road. The conclusions arrived at by the expedition, which were conducted under W. T. Jennings and Major Villiers-Sankey, city surveyor, are as follows: That a new line from or near Toronto, Barrie, or Waubaushene north to or near Sudbury, etc., would open up a new section fully as good as that between Gravenhurst and North Bay, and that such a line would shorten the distance to Winnipeg by fully fifty miles; that a new line in the meantime from, say, Verner, northeast to Temogami Lake, would be of immediate benefit in developing that large section in its very near future; that a line from North Bay to Temogami and north to the Blanche river country, a hundred miles, would make an available outlet for the lands and forest products of these regions, including the extensive valley of the Montreal river; that a through line to James Bay should be constructed by way of the last named route; that the ultimate extension of the line from the divide to James Bay is a matter for future consideration.

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For The Canadian Engineer.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

PART II.

Chap. 1.—Track.

ARTICLE I.—FORM OF ROADBED.

The first essential of a good track is proper drainage; there can hardly be good track without it, from which it naturally follows that too much care cannot be taken in forming a roadbed at the completion of its construction, which will have good drainage in itself; even with abundant and good ballast, drainage is necessary, while it may be the saving feature of a track surfaced with inferior or scanty ballast. Plate XXII. shows types of roadbeds in use in America, and it will be seen that most of them have a slight slope each way from the centre, forming a rounded surface onto which the ballast is laid; the crown at sub-grade should be 3 to 4 inches for a single track in cutting, but may be partially omitted on embankments, as future settlement tends to round off the corners and aid drainage. Should low spots exist in the centre of the roadbed beneath the ballast, water will lodge there and soften up the earth so that the ties will sink under the churning action of car and engine wheels. Although not essential or always done, it is an advantage and an economy of ballast to elevate the roadbed on curves parallel to the expected plane of the ties and rails; this practice also gives an elevated track before ballasting is commenced. Widths of roadbed vary with the climate and materials. Embankments vary from 10 feet for cheaply built roads in the Southern U.S.A. to an ordinary standard of 16 feet for Canadian and Northern U S.A. first-class roads; cuttings vary similarly, but are usually about 6 feet wider than the embankments for making ditches; for purposes of handling snow it is not found advisable to make cuttings less than 22 feet in Canada, although rock cuts with narrow ditches are sometimes made 20 feet. To all of these, 12 to 14 feet are added for each additional track, and in case of very wet cuttings extra width may be needed for proper drainage (see Fig. 8, Plate XXII.), or a tile may be laid beneath the cut ditches to drain the sub-soil (see Fig. 5, Plate XXII.). Ordinary cut ditches are about three feet wide and one foot deep, and may be wedge-shaped (Fig. 7) or trough-shaped (Fig. 8), but although the latter is often dug in the first place, the weight of evidence is in favor of the former, which is formed by a flat slope of from 2 to 1 to 6 to 1, starting from near the edge of the ballast and meeting the cut slope at an angle. The tendency of such a ditch is to direct the water well away from the track and thus prevent undermining of the ballast. Cut ditches should be led well away from the mouth of the cuttings to avoid scouring the foot of the adjacent bank, indeed, the cut ditch on the upper side should join the catchwater ditch and continue down to the entrance of the nearest culvert as a berme ditch placed five or six feet away from the foot of the bank. By a thorough system of ditching at the conclusion of construction much trouble and expense can be avoided and the energies of the track gangs during early maintenance may then be devoted to other things. To make the ditching system complete, catchwater ditches should be dug along the upper side of every cut, placed six or eight feet back from the top of the slope, the earth from them being placed inside; these ditches should collect all those small trickling streams and general hillside wash that would otherwise run down the cut slopes, carrying sediment into the cut ditches. These cut ditches are often soon neglected during early maintenance, and extra ties, heaps of unused ballast and stray boulders block the drainage, while in later years rotten ties and weeds need watching. Too great stress cannot be laid on having clean straight cut ditches with a uniform fall.

Of late years construction has been usually very rapid, and embankments, if made of earth, will rarely have completed more than half of their shrinkage; this will vary in amount with the method used in building the bank, being greatest when built with wheelbarrows or machine graders from side ditches, and least when flat or wheel-scraper work has trampled it in thin layers by the horses' feet, etc. For these reasons all banks made of earth ought to be left full width and a certain per cent. of height at each point above the theoretical grade line. Of course, abrupt changes in track surface are not desirable, even for a short time, and such allowance for shrinkage should be made with judgment according to the merits of the case in hand at each point bearing in mind what the ballast is costing, the expense of re-lifting sunken track and the large amounts of extra high-priced material needed if this allowance for shrinkage is not made before grading is completed ; on page 150 the per cent. of shrinkage of different materials is given, which will serve as a basis for estimating how much extra height should be given to the banks ; if construction has been completed in one season at least one-half these amounts are necessary.

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* This series of papers will be issued in book form as soon as they have appeared in The Canadian Engineer.

ARTICLE 2—BALLAST.

The quantity of ballast used is a purely financial question, and up to a usual limit of 12 inches underneath the ties, the more the better, can track be maintained for the same cost ; 12 inches under ties takes about 3,000 cubic yards per mile ; 6 inches under ties takes about 1,800 cubic yards, including filling around ties as in Fig. 8, Plate XXII., but with no allowance for sunken banks and extra material. The functions of ballast are :

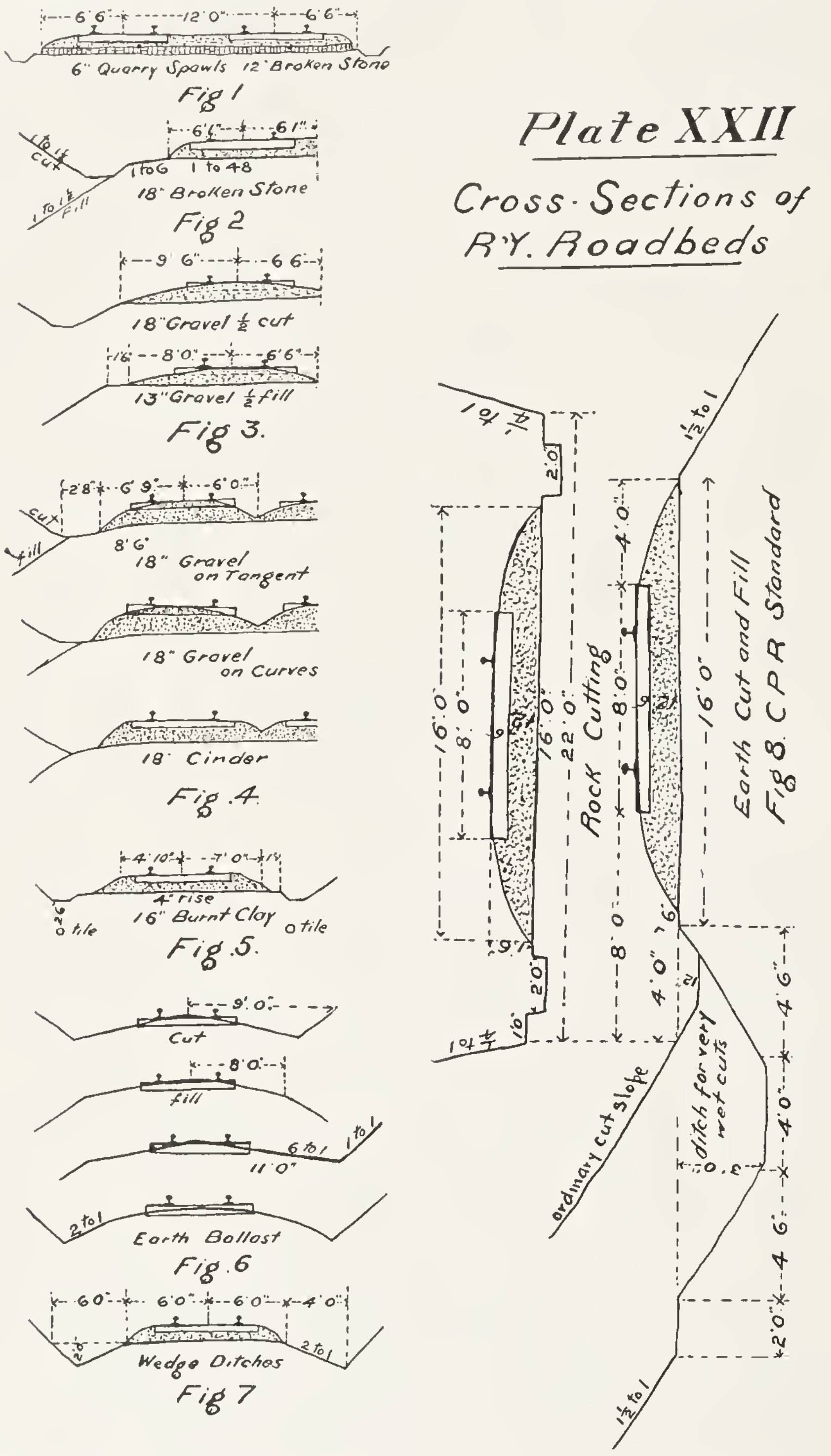


Plate XXII
Cross-Sections of R'Y. Roadbeds

(1) To afford lateral, longitudinal and vertical support to the ties sufficient to keep the track in line and surface without incessant track labor.

(2) To carry off all water as rapidly and thoroughly as possible after rain storms or thaws.

(3) By drainage to lessen the action of frost in heaving track during the winter and spring.

(4) To give elasticity to the roadbed.

The following materials are used more or less extensively for ballasting and are given in order of merit as nearly as may be :

(1) Broken stone to a 2-inch ring ; coarser underneath.
(2) Furnace slag and cinder.
(3) Coarse, clean gravel.
(4) Broken bricks or any form of very hard burnt clay.
(5) Sand not so light as to be easily blown away.
(6) Earth, usually compact clay, seldom loam.

Broken stone ballast, although expensive and hard to tamp and surface with, gives the most durable and satisfactory track with least labor for maintenance ; only roads with heavy traffic can afford to have it, as it costs from 75 cents to $1.25 per cubic yard in place. When used, it is generally flush with the top of the ties for about 1 foot beyond their ends, thus giving lateral support, and side slopes rather steep (about 1 to 1). A very finished appearance can be given by laying a margin of stones to line by hand, and keeping the rest of the roadbed, outside, free of ballast and grass. The slag from blast furnaces, if properly cooled and broken, makes a very good and durable ballast, but its use is evidently limited in area and the price will vary according to circumstances ; cinder also is a valuable ballast, but limited in quantities. Probably gravel may be looked on as the ballast more generally used in America than all other forms combined, because of its wide distribution and general utility. When clean and fairly free from sand and large boulders, it drains well, surfaces easily, and holds track from all but lateral movement ; in this it is deficient as it will not stand steep enough to admit of the ends of the ties being fully submerged, unless a very wide roadbed is used. (See Figs. 3, 7 and 8, Plate XXII.). The cost of gravel ballast in place varying with length of haul, may be put at 15 cents to 20 cents per cubic yard if loaded with steam shovels from a good pit and unloaded by ploughs, but will run as high as 40 cents when material is manually handled from pits with heavy stripping. In all cases the stripping of pits should be attended to, and all inferior material wasted or put on low or narrow banks. The ballast material should be of a uniform quality, as any patches of loam or clay mean just so many sunken spots in the track.

Sand ballast creates dust in summer which injures the rolling stock, does not hold a track well to surface or in line under heavy traffic, and has a tendency to hold water and heave track in the spring ; unless very coarse it is not at all a good investment if other ballast can be obtained. In such situations many roads have resorted to burnt clay or broken brick, but unless well and uniformly burnt, almost to vitrifaction, it is not a very durable material. In mild climates, such as Southern U.S.A., many railways have ballasted with clay taken from ordinary cuts, either from the cut slopes or hauled by train from the nearest point. If the clay is of a compact nature, and such a cross-section as one of those in Fig. 6, Plate XXII. is used, it will soon get beaten down and shed ordinary rains without any water permeating the roadbed. It is evidently a very cheap way to ballast, and in the absence of other cheap materials may be very justifiably used in such climates by roads of light traffic and meagre resources. Except in the case of broken stone, laid with teams, from adjacent fields, the ballast is put on, after the track is laid, by train loads, and, in so doing, unless the newly laid track is at once roughly surfaced, and trains run very slowly over it until a light " lift " is first put on and the track fairly well lined and surfaced before the ballast trains are allowed to run at a high speed, we may expect permanent injury in the form of bent rails and cracked angle bars, especially as the track is often not fully tied, spiked or bolted. In surfacing and lining track it is well to remember some general principles applicable to all materials and at all times.

(*a*) The coarser material available ought to be put underneath, *i.e.*, on the first lift.

(*b*) When the supply of ballast is limited and subgrade sunken on the banks, it is better to be satisfied with a track having local depressions below the theoretical grade line, rather than to rob the sides by building up a high, narrow track to the true grade, as such a track will soon sink and get out of line—being deficient in lateral support.

(*c*) Each tie should be tamped equally well, because even one tie, without support, acts like a force pump ; each passing truck, by suddenly depressing it, compresses the air under it, forces out more ballast, until there is a cavity formed, a lodging place for water and a permanent sag in the rail.

(*d*) Ballast should be tamped more firmly under the rails than under the centre of the track, because a centre bearing will cause a rocking motion which will increase rapidly, especially on banks, where the sides are apt to sink more than the centre anyway.

(*e*) Surface is rather more important than alignment, although not so easily obtained or seen by a track foreman.

(*To be continued*).

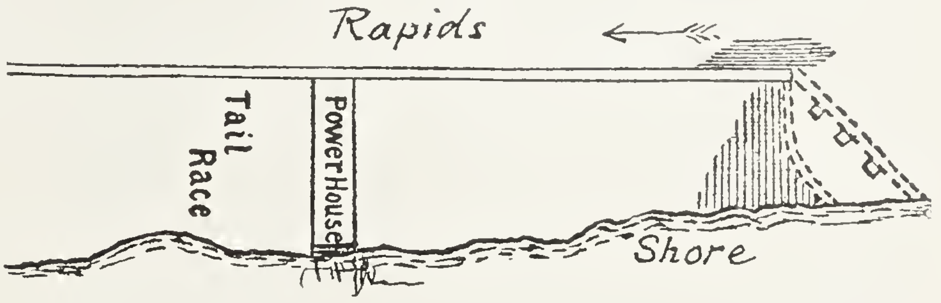
FRAZIL ICE IN THE LACHINE RAPIDS.

The Lachine Rapids Land and Hydraulic Company has been supplying electric current steadily to Montreal since last winter and has had four dynamos running, delivering 3,000 h.p. Some difficulty was again experienced, during the severe weather early last month, in obtaining a sufficient head of water to keep the plant in operation. The lighting companies subsidiary to the Lachine Rapids and Hydraulic Co., the Imperial and the Temple Cos., had to start up their steam plant, and the Imperial borrowed a dynamo from the Royal Electric Co.

The two chief difficulties in the problem of maintaining the head which the engineers of the Lachine rapids development had to contend with in winter were the sudden and very great fluctuations in the river level below the rapids, caused by ice jams in the river and the formation of frazil ice. It has been found that the changes in the river level at the city are not so important as was anticipated, but a great deal of trouble has been found through the formation of an ice dam on the rock bottom of the shallow stretches immediately below the tail-race. On the occasion referred to, we are informed, the level of the water in the tail-race rose ten feet owing to this cause and for a time the head was reduced to three feet. The removal of the rock in the shallows below the tail-race will probably remedy this defect, and it becomes only a question of how much the company is prepared to expend in securing itself against similar occurrences.

The second difficulty, that caused by frazil, is as yet unsolved, and if the report is true that the company intends to install a steam plant in Montreal as an auxiliary, capable of running all the arc lights in the city, it would suggest that the final solution was believed by the company to be still remote.

The recent obstruction of the intake which reduced the level of the water in the head race from nine to five feet, as we are informed, was due to the existence of frazil. The construction of the intake will be seen at the top of the accompanying rough diagram, which we reproduce from the Montreal Witness. Between the pier head and the shore are placed in a slanting line three rock-filled caissons, and along the upper side of these represented in the illustration by double dotted lines is stretched a boom thirty inches deep. A little lower down is a second boom represented by the lower pair of dotted lines. This latter is four feet deep. Between these two booms is maintained an open sheet of comparatively still water. These were constructed so that the frazil floating down the current would be stopped by the first boom and carried away by the current which sweeps along it. Should any get past this boom the clear space of quiet water was maintained for it to rise in, and the second boom constructed to catch it. The vertical shading in the illustration shows where a part of the construction dam has been left. Though this does not come up to the surface it is so near it that pieces of ice catch in floating over it. This obstruction lessened the current sweeping the outer boom and also caused a large eddy. In this way the frazil was not carried off as it should have been. The snow also, which fell heavily at the time, drifted into the open space between the two booms, formed slush, and this getting under the boom rose again immediately and froze to the underside of the ice. Thus between snow and frazil the intake became frozen solid from top to bottom over the area shown by the horizontal shading. This had to be blasted out. To prevent a recurrence of the snow difficulty, a snow fence has been constructed across the ice below the intake. The Witness states that, to prevent the frazil coming in, a few feet will be removed from the top of the old construction dam so that ice may pass over it freely and the outer boom be continually washed by a swift current.



There can be very little doubt that if any solution of he difficulty can be reached, the engineering staff of the company will arrive at it. It has been established that frazil does not form in ice-covered water that is warmer than the open stretches, and frazil is only formed in water whose temperature is below freezing. The vast amount of the St. Lawrence which is kept open by the rapids and swift currents materially cools a large body of water, and this is especially true of the river at Lachine, where for a distance of about six miles above the company's works the river is almost entirely open. In these open rapids frazil is formed in great quantities, and it is yet to be shown that at the bottom of such an extensive stretch of rough open water there can be maintained a sufficient area of still water by which the turbines may be driven and from which the frazil coming down the river can be excluded.

ROPE TESTING.*

BY GEO. A. M'CARTHY AND ERNEST G. MATHESON.

Almost all departments of engineering have been so thoroughly exploited that wherever you may carry your researches you find that you are by no means the pioneers. If this leaves less room for originality, yet it furnishes many useful hints in regard to methods to be pursued in order to obtain the best results with the least effort and in the most satisfactory manner. In our investigation of the strength and other qualities of ropes, it was assuredly not in the multitude of data, but in their absence, where lay our chief difficulty, or if these data existed we failed to get them within our reach, therefore, in so far as we are concerned, this thesis is almost wholly original.

Before entering on the subject of rope testing it might be well to glance for a moment at the method of manufacture of the more ordinary kinds. In making the strand of the rope, the proper number of yarns are passed through a register plate, and from that into a tube into which they fit very tightly. This bundle of yarns is then fastened to the forming machine which travels backward down the walk, pulling the yarn through the tube and at the same time twisting the bundle of yarns into what is called a strand. The angle of this twist is in all cases as nearly as possible 37°. Three of these strands, having been hauled the whole length of the walk, are thrown over upon the laying track and each hooked on to a separate spindle of the laying machines which stand at each end of the walk. One machine is stationary and the other travels a little when the twist goes into the rope. This is on account of the rope shortening as it gets twisted. To prevent this machine moving too quickly, a brake is arranged to grip the rails. When the strands are thus hung upon the machines, at each end of the walk, each strand on its own spindle, and the brake in position, both machines are started so as to put more twist into the strand. This turn or twist of course reduces the length and the twist is regulated by the amount the strand is shortened. If 100 fathoms of rope is wanted with 6 per cent. of hard in it, 6 fathoms of hard is put into the strands, after the strands have first been formed at an angle of 37° as already mentioned. In other words, a strand, which has already been formed at an angle of 37°, is taken and twisted by these machines until it shortens say 6 per cent. of its original length; then we have a strand with 6 per cent. of "hard" in it. Generally speaking the hard ropes wear best, but are very difficult to handle in water. The soft ropes are much more pliable and easier to handle, but they do not stand wear as well as the harder qualities. The soft ropes are usually the stronger.

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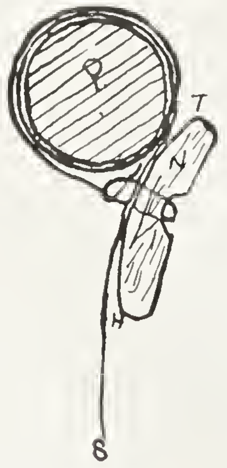
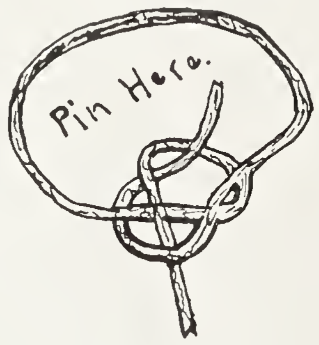
*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in THE CANADIAN ENGINEER.

With this brief account of the process of manufacture we will now proceed to describe the testing of the ropes as carried out in the laboratory. At the very threshold the difficulty of holding the specimens was met. Wooden and iron specimens can be so formed that the portion gripped by the testing machine will be sufficiently strong to hold the specimen until fracture occurs in the test piece in the position desired. It is not so, however, with rope. Moreover, it is obvious that even where the rope is made fast round a pin of considerable diameter, some of the fibers will be strained greatly more than others, thus preventing the results obtained from being the ultimate strength of the material. It was this strength we desired to obtain, although it may seem that results gotten under conditions which obtain in actual practice might be more valuable. We desired comparable results and to this end the ultimate strengths are the most serviceable.

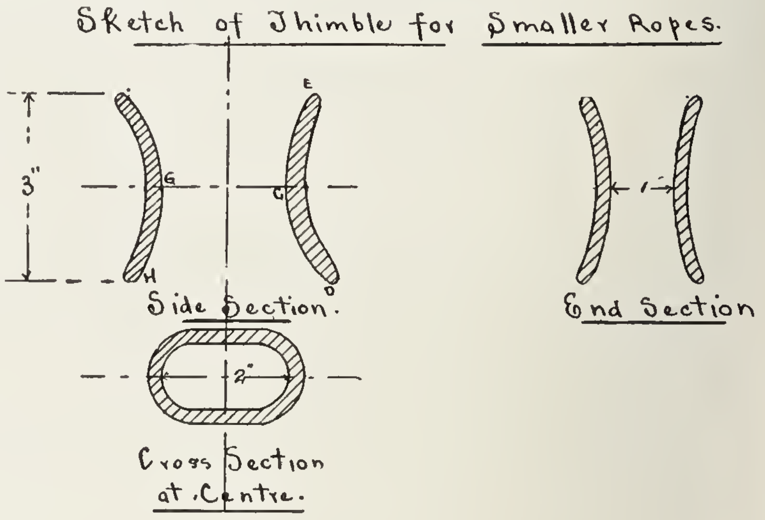


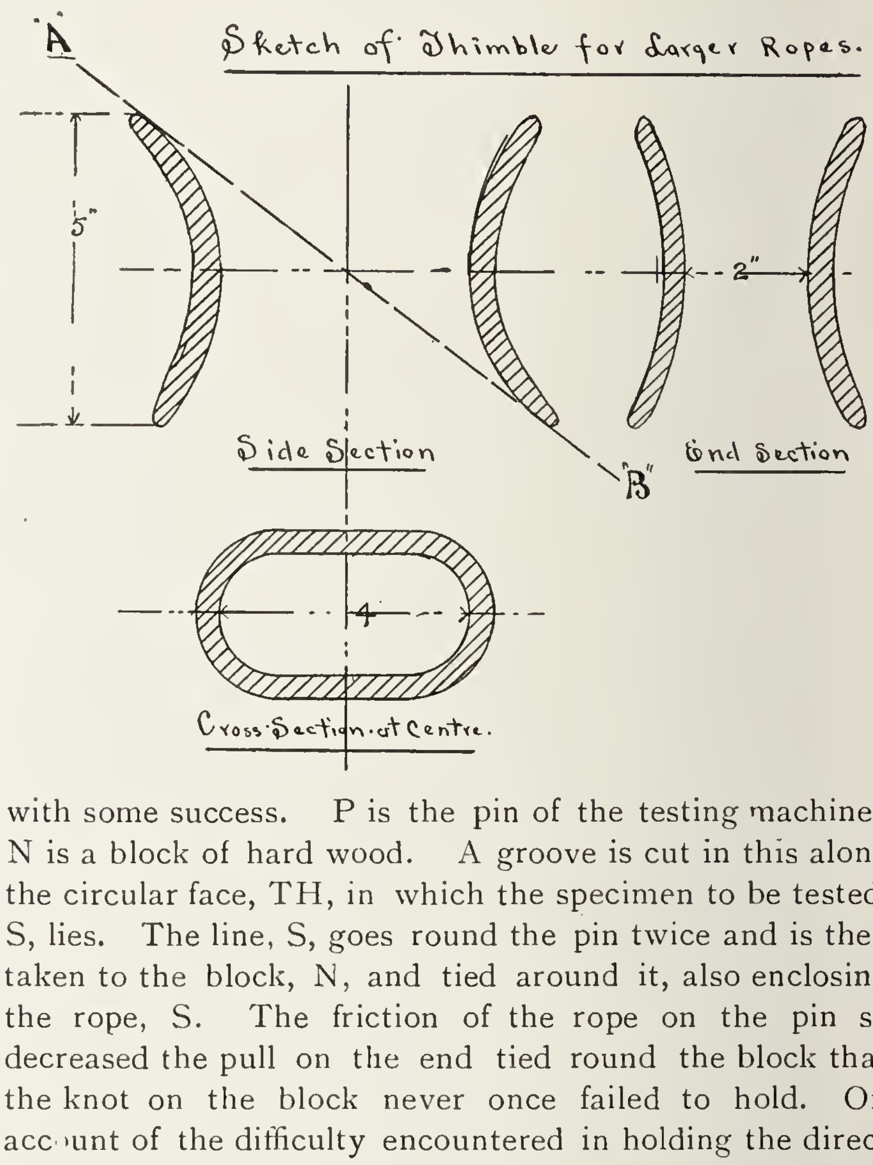


Much difficulty is usually found to hold ropes by means of knots when great stress is applied. By means of the "bowline" knot, a sketch of which is given, we overcame this trouble.

There was no slip nor give; but we soon saw that the strength of the rope was by no means fully developed. The rope failed invariably at the knot, so we were compelled to have recourse to some other contrivance. Splicing was, after consideration, rejected as requiring more time than we had at our disposal.

A contrivance as shown in the sketch below was tried with some success. P is the pin of the testing machine; N is a block of hard wood. A groove is cut in this along the circular face, TH, in which the specimen to be tested, S, lies. The line, S, goes round the pin twice and is then taken to the block, N, and tied around it, also enclosing the rope, S. The friction of the rope on the pin so decreased the pull on the end tied round the block that the knot on the block never once failed to hold. On account of the difficulty encountered in holding the direction of the block parallel to that of the rope, the device was abandoned. We had the satisfaction, however, of seeing the specimens tested in this manner break in the free, straight portion and not at the fastening. Failure was a successful tutor. We began to clearly perceive the principles underlying a satisfactory holder, and we next tried an oval shaped thimble with flaring ends which were open. The idea was to obtain a holder which would not injure the fiber of the rope; which would not occasion any sharp bends in the strained portion, and at the same time would leave the specimen free to move in the direction of the stress. The thimbles answered very well indeed. The following is a description of them which, with the accompanying sketch, will clearly exemplify the method of working.





The thimbles were made of iron, the smaller about $\frac{1}{4}$ inch thick and the larger $\frac{3}{8}$ inch thick. The dimensions were as shown on sketch. It will be noticed that the radius of curvature along the surface, CD, is the same as that along FG. The radius along CE being also same as that along GH. The radius along CD and FG is less than that along CE and GH. The fact that the thimbles when in use would not remain in a vertical position rendered this feature of the design necessary, so that a line joining the two extreme corners would be tangent to the curve where the line entered and left the thimbles, as AB. When this was the case a rope could not possibly be injured by the curve of the thimble, although the great pressure, even of a smooth surface against the strands of the rope, might possibly crush the fibers to some slight degree. The method of securing the rope was as follows: The free end of the rope was put up through the thimble, passed completely round the pin and brought down again through the thimble. The end was then tied with one or two knots to a short piece of piping about one inch in diameter. This piping reached across and rested against the lower end of the thimble, thus preventing the end of the rope from passing up through the thimble. It was found that, on account of the friction of the rope against the pin, one knot of the rope on the toggle was quite sufficient to hold it. In fact in some instances there was not sufficient rope to tie one knot around the toggle. When this was the case the rope was unstranded and the toggle inserted between the strands and the strands tied around it; even this method of making the fastening never failed.

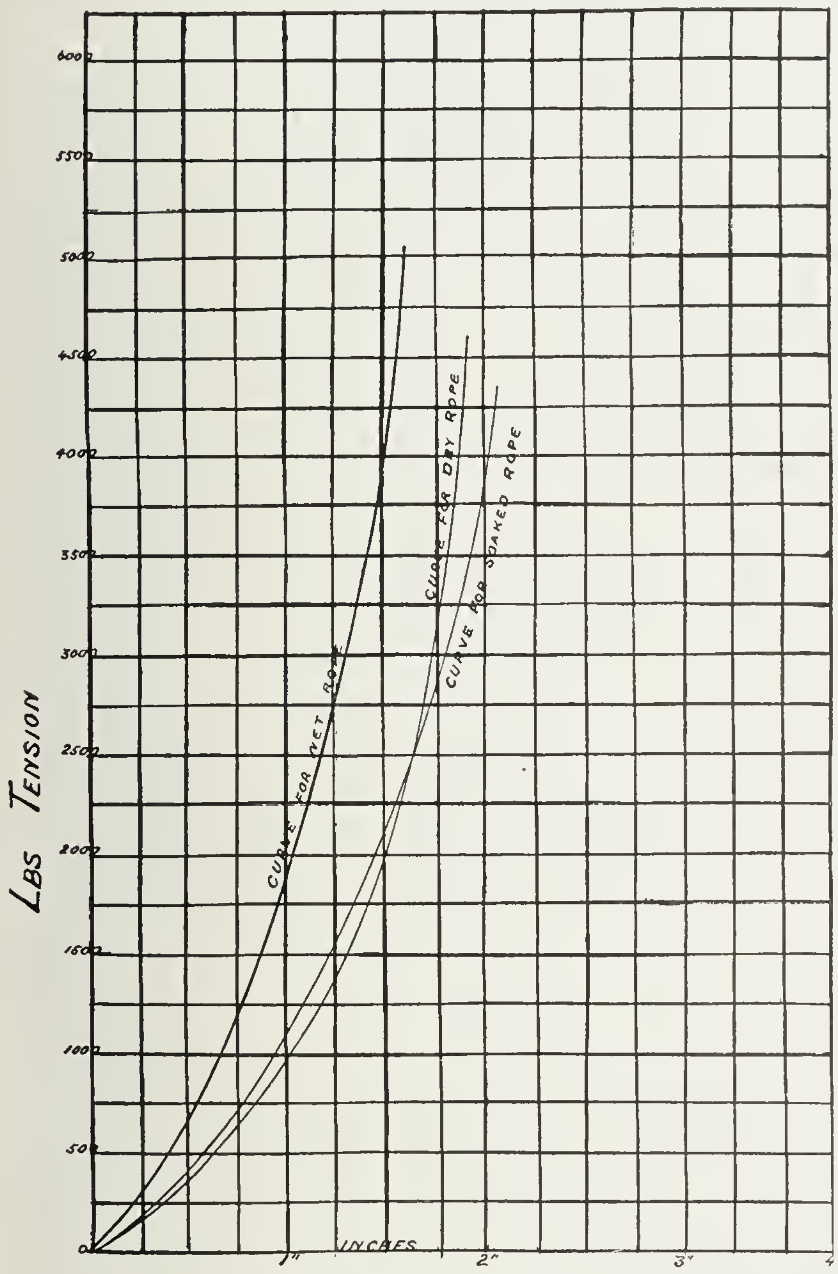


DIAGRAM SHOWING RELATION OF EXTENSION TO LOAD
FOR
MANILLA AND HEMP (TARRED) ROPE

The Wicksteed testing machine—a machine of the balance type—was the one used. The total range of the machine for ordinary work is about three feet. This was, however, found inadequate for our work owing to the excessive elongation of the rope, especially when wet, and we were compelled to dismantle the machine to some extent. The part C and the corresponding part together with the vertical rods D, P, E, F, (see accompanying illustration) were removed, leaving the pins B and A with their eyes surrounding them. This gave a range of about five feet six inches, which in a solitary instance was not enough. The vertical rod, G, with a corresponding one opposite to it connect the crosshead, J, to both a hydraulic and an electric motor, the former for heavy work where speed is not a desideratum, and the latter for more rapid work where power not beyond 5,000 lbs. pressure is needed. The range of the hydraulic ram was about 10 inches. This was needed whenever the power exceeded 5,000 lbs. When the test was begun the crossheads were usually about two feet apart; yet the distance between them often reached 5 feet 6 inches before rupture. The pins were about 3 inches diameter, and the rope was usually placed twice on the pin in order to increase the friction.

The method of getting the extension was as follows: Owing to the great stretch of the rope no extensometer could be employed. The unequal give at the different ends excluded the setting up a scale beside or attached to the specimen. Workings on the surface were debarred by the want of definition. Fine, smooth tacks were inserted in the rope at the required distance apart. The distance could be conveniently measured, and we hoped this was a final arrangement, but here again we were doomed to disappointment. Incredible as it may seem even these very small tacks caused the rupture to take place at the points of their insertion, as the tabulated results will show. A very convenient and easily adjusted device was finally employed. It was the adaptation of a contrivance based upon the principle of the pinch-cock to our work.

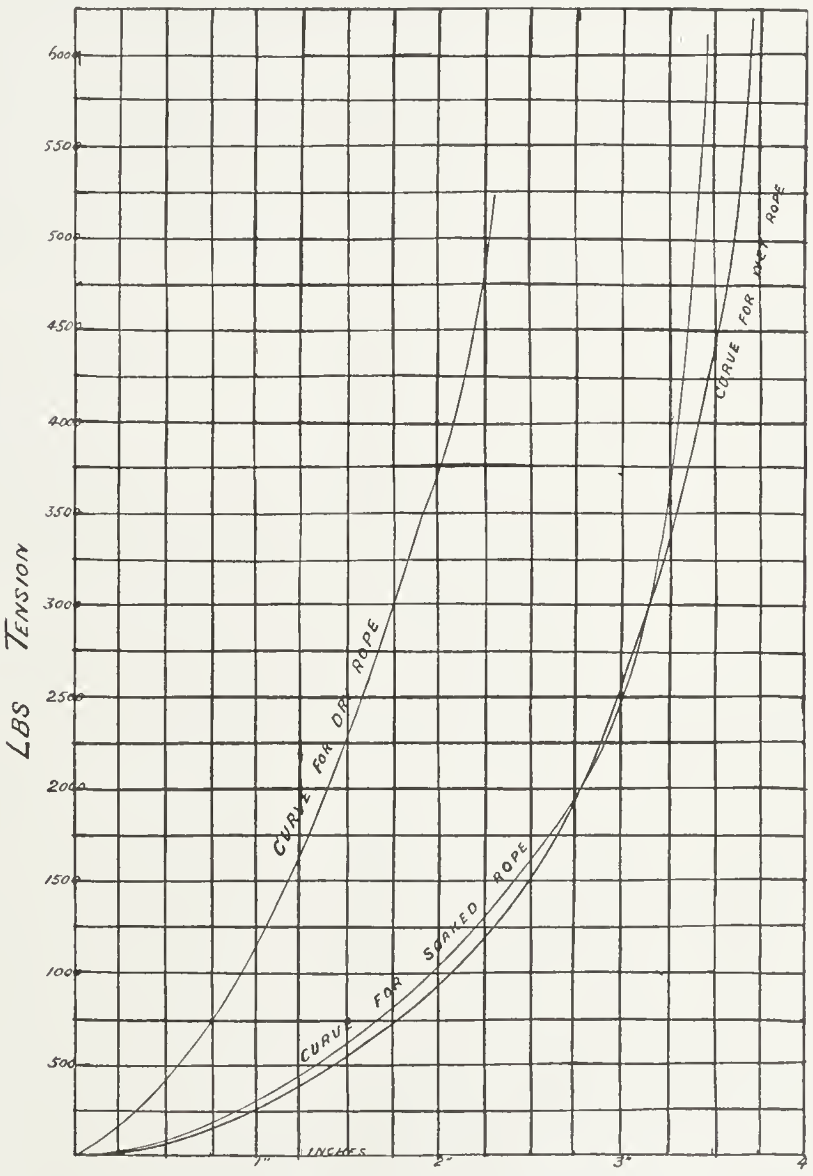
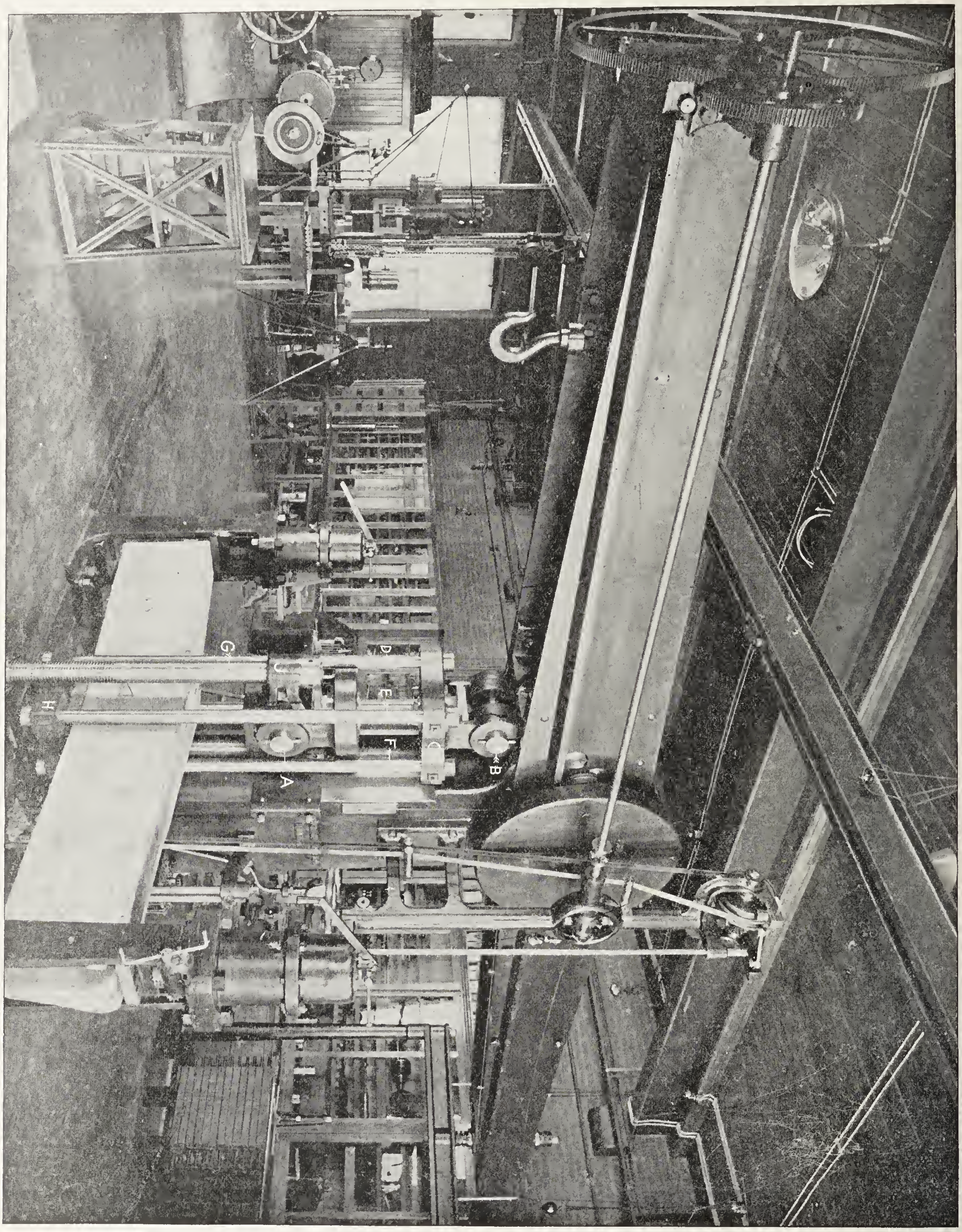


DIAGRAM SHOWING RELATION OF EXTENSION TO LOAD
FOR
MANILLA AND HEMP (UNTARRED) ROPE

SHRINKAGE.

The percentage of shrinkage for the different kinds of



rope under different degrees of saturation is given in the following table :

Kind of Rope.	Time Immersed 2-6 days.	Time Immersed 6 weeks.
Manilla	5.0 per cent.	5.7 per cent.
Tarred manilla	2.0 "	2.8 "
Manilla bolt rope	6.9 "	6.0 "
" " yarn	3.5 "	6.2 "
" yarn	5.5 "	7.6 "
Sisal	5.7 "	7.6 "
Tarred hemp ratline	6.7 "	8.0 "
" " bolt rope	6.6 "	7.9 "

The table speaks for itself. It will be seen that the rope shrunk more when immersed for six weeks than when immersed for one week. The wetting had not such an effect in this direction on the tarred as on the untarred specimens. The above results are averages. In the same kind of rope there was some variation owing, no doubt, to the many factors entering into the work which tended to make the results not uniform. The principal one of these was the probably unequal tension put on the rope when measuring, dry and after soaking. The tension should have been measured with a spring balance to get the best results. On account of the ropes having to be immersed in a coiled position (the smallness of the trough at our disposal preventing them being laid out at full length) it was found almost impossible to thoroughly straighten the larger ones after wetting without putting them under considerable strain. This fact would tend to make the percentage of shrinkage less than it otherwise would be.

(*To be continued*).

For The Canadian Engineer.

A SYSTEM OF PLUMBING.

BY W. M. WATSON, TORONTO.

For upwards of two years articles dwelling on sanitary appliances have appeared in the columns of The Canadian Engineer, and its readers will more readily understand the arguments used in this paper if they have read the articles in previous issues. I have shown that such sanitary appliances should always be plain and easy to repair and understand; that the excesses adopted lately in constructing plumbing appliances and public sewers by some professional sanitary and municipal engineers, is dangerous to the public health, and unnecessarily expensive.

In a former article on sanitary appliances, I stated that the plumbing and sanitary arrangements of last century were healthier than the elaborate obstructions of the present system. At that time they had the good judgment to cause all pipes carrying foul matters to pass to the outside of the building at the nearest possible point and to have as short a length of pipe and as few bends as the arrangements of pipes would allow. The sewage and refuse were hurried from the premises by slowly turned bends and direct routes, but the engineers and medical officers of the present day demand numerous obstructions, and often call for the most roundabout method of laying down private drains, so that they require inspection or lamp holes, together with special ventilation shafts to prevent the drains becoming blocked and the sewer gas that they generate from poisoning the inhabitants.

E. M. Close, chairman of the health department of the Birmingham Sanitary Institute, England, when giving his annual address at the 17th Congress in September last, stated that placing interception traps and breather pipes on private drains was wrong, and that all private drains and public sewers should have free and uninterrupted ventilation throughout, and in another remark declared that the architects of the present day appeared to have entirely lost sight of the question or art of drainage. At the same meeting W. Hannan stated that house drainage could easily be kept free from sewer gases; it was only necessary to arrange the waste pipes so that sewage would secure plenty of aeration, which would cause it to remain fresh during the time the fluid was rolling from the house to the outfall end of the main sewer. He also stated that all traps were putrefying machines and incubators, where dangerous germs are bred that pass out into the sewers and rapidly multiply. The whole discussion of this select company of sanitarians at the Congress showed that to improve sanitary apparatus, the use of traps and similar impediments should if possible be avoided. Some expressed the opinion that the time was not far distant when the use of traps to keep back sewer gases would be totally discontinued and become unnecessary.

This seems to me exceedingly probable, for I see no reason why a new town cannot so arrange its refuse and sewage business that it can be removed in a way that sewer gas and foul, unhealthy odors cannot possibly generate in any part of the pipes, and also having the advantage of costing considerably less than the intricate obstructive system at present forced on the people. To do this there must be separate drains and sewers, one set to carry the sewage and the water from the roof and yard of dwellings, and another set to carry the storm water from the streets and land, together with any clean water springs that are within the watershed. To do this the sewers must not be too large. Every branch taken from the street sewers must be taken from the crown, and continue with an upward grade, void of any interruption or interception traps, to the highest point of the building it serves, or the nearest building or large tree. Every separate line of sewer serving a street must have a shaft at its lowest point for the inlet of fresh air, and another of the highest terminating point to form an outlet of air in a way that even the smallest pocket is avoided where it might be possible for air to lodge, and to ensure a free and rapid circulation of air from the lowest point of each and all the street sewers to above the housetops. Then the plumbers must fix the waste-pipes in the interior of the buildings on the same plan, viz., every separate line of waste-pipes must be continued to above the roof, independently, and in no case must any two or more lines be joined together. It is important that care should be taken to ensure the above related points being carried out in the smallest details, because those who have followed my remarks in previous articles will know that sewage contains the germs that will if properly set to work purify and make clean again the polluted fluid, and all that is necessary for the engineer and mechanic to do is to so arrange the carrying pipes that the sewage during its transit is broken up into particles, and that an unlimited supply of fresh atmospheric air is provided at all points and places, ready to be absorbed by the fluid when needed.

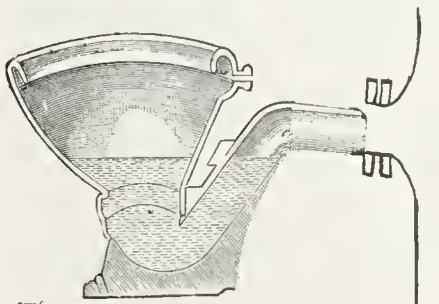


Fig. II

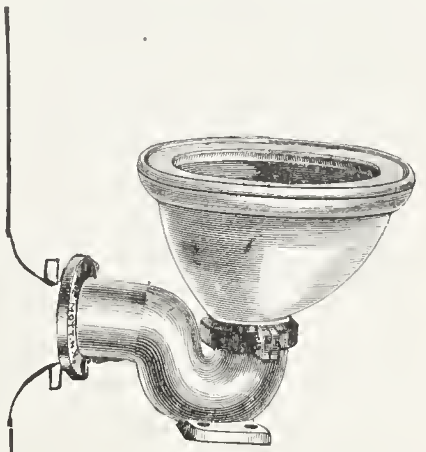


Fig III

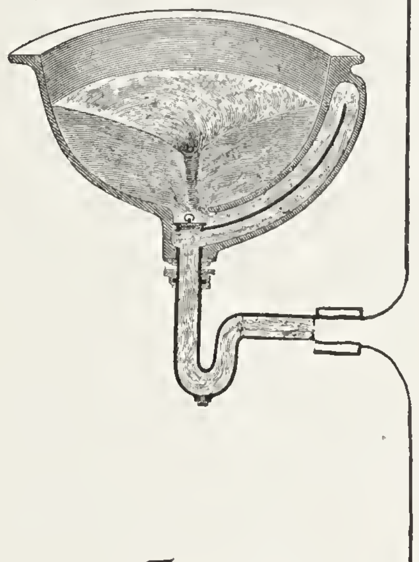


Fig IV

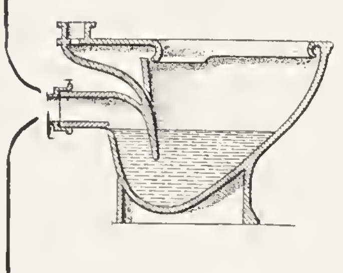


Fig. V

If this be done no sewer gas will ever be generated, because the sewage will remain fresh if kept in rapid motion until it reaches the terminating end at the outfall. If no sewer gas is generated then there need be no appliances used to prevent sewer gas doing injury to the public health. The experiments made by Herr Unna, at Cologne, proved that when sewage was falling down a vertical line of pipe it split and divided into thin threads that enlarged the stream to the full size of the soil or other pipe used for the discharge, and that during its fall down the vertical pipe it got mixed and carried with it at least four times its own volume of atmospheric air, drawn in through the open end above the roof. All plumbers should bear this in mind, for it proves that their work is very important, not only in preventing sewage from generating poisonous gases, but that they can by properly arranging their lines of waste-pipes cause the sewage to commence purifying itself at the very moment that the clean fluid has got fouled. In previous issues I have supplied illustrations and descriptions how to do this, and tried to prove that the system of connecting two or more lines of pipes together is decidedly wrong and injures rather than assists ventilation by retarding the proper circulation of air through the whole length of waste-pipes, which must be the object aimed at to ensure a high standard of health.

It is the practice in cold countries where the atmosphere is impregnated with sea salt, or where the temperature during any part of the year does not fall too much below the freezing point, to continue the old eighteenth century method of running all soil and waste-pipes outside the walls of the buildings, and passing all waste-pipes from interior water-closets and other sanitary appliances through the house walls at the nearest convenient points, and they all work well, but the practice would not work smoothly in the northern parts of this continent. I have a system of this kind working here in Toronto on the outside soil-pipe plan, and so long as I attend to the arrangements myself it answers all right, but if a tap be leaking and allowing the water to dribble down the waste-pipes when the temperature is below zero, it freezes at the point where the short piece of horizontal pipe that passes through the wall joins the vertical pipe fastened to the face of the outside wall, but when this small leakage is avoided, it answers well even here at the lowest temperatures, but the latest American system of erecting stacks of soil-pipes of good metal and joints, on the open principle, vertically through the interior of the buildings, can be made quite as safe and sanitary, and have the advantage of not being subject to frost. I have before suggested a way of arranging waste-pipes that would ensure the freedom from sewer gases in dwelling houses when a connection has been made to the present sewers or sewers that manufacture sewer gas because they have not been laid so as to be self-cleansing, aerated properly (see article on sanitary appliances published in The Canadian Engineer in April, 1897), and I here propose to show a way of connecting the branches from sanitary fixtures to vertical soil-pipes or any other line of waste-pipes serving other fixtures that are too far removed from the soil-pipes to be properly connected with it, in the way shown by these illustrations. I might add that no two lines of waste-pipe which terminate with an open end above the house roof should be joined together on the vertical line, except on the street side of the quarter bend at the foot, and in no case where there is another waste-pipe that branches into the vertical stack at a lower point. When this error is made the suction of air that passes down the lines of pipe when slop water is sent down, is impeded, and the current of air that comes up from the street sewers to the housetop is curtailed by friction, having to split at the dividing junction.

It should be the aim of all plumbers to avoid as much as possible low-grated horizontal pipes and pipes too large for the fixture or for the waste plugs in the fixtures they serve. They should avoid all sharp angles and junctions on main lines of waste-pipes, and any roughness or solder drops on the inside of the waste-pipes. They should also aim at having the insides of all waste-pipes smooth and free from the least impediment throughout the whole length of the pipes, and neither increase or decrease the bore of any vertical line of waste-pipes from the junction at the ground line to the terminating point above the roof. Herr Unna shows why care on this point should be observed in the Cologne experiments. They should also do away with the dirty, unsanitary practice of placing waste-pipes, bath traps and water-closet bends between the floor boards and the ceiling, because they are apt to freeze and defects cannot easily be seen or repaired. The sweating of the pipes when the temperature of the air is higher than the water passing through them causes the ceiling to soften and smell, and there are also more angles and sharp turns in the pipes than there need be or is good to have in waste-pipes for the health of the inhabitants. For the sake of securing a fine outside appearance nothing should be done to jeopardize the smoothness or increase the friction, or retard the flow of air or fluid within the pipes. All branches made in hard metal pipes should be made to bend slowly both above and below the branch inlet to allow for the easy escape of the air as well as the sewage (see Fig. 1 to 5), and at the same time leave the vertical pipe free to pass down the atmosphere air drawn in by the falling sewage, and also to do away with the shoulder space that is at present usually created if an ordinary T. Y. is used, which always forms an air pocket and breeding space for microbes. In joining lead pipes together this could not be done, nor is it necessary, because in the usual course of fitting a short length of horizontal pipe of about 1 inch bore and 2 feet long would be used to carry the waste water from a wash-basin to a 2-inch or 1½-inch vertical stack of lead pipe; the fluid would rush through the short length of pipe fixed between the basin and vertical line of larger lead pipe at full bore, and dash to the opposite side of the larger stack of vertical pipe, whose top end was open and extended to above the roof, then the fluid would split up and suck down the air from the roof and take a large quantity with it down to the common sewer. And if the basins, the baths, the sinks and wash tubs can all be placed close to the vertical line of the soil-pipe they should be joined to it on the same principle as shown (see Fig. 3) because the more a pipe is used the better for health.

The illustrations show four different kinds of water-closets. The syphon is a closet, a pattern that I cannot approve because it contains a double trap, one which cannot easily be emptied or inspected. Then it delivers the water down the soil-pipe with a rush in bulk and unbroken, therefore the fluid does not get mixed with air in the vertical soil-pipe as it should do, but draws the air behind it in a bulk form which never mixes with the sewage, and when the air reaches the point where the sewer is larger in bore than the interior of the soil-pipe, and the vacuum becomes broken, then the air returns to the outside atmosphere the easiest way possible without performing any aeration of sewage. Fig. 2 is a similar closet without the syphonic part, which I approve because the trap part is independent of the bowl and can be set to point to the right or left hand, so that the soil-pipe can be erected on either side of the closet bowl, and the bowl can be set with the flushing horn to the rear, which is the proper position to receive the flush-pipe from the cistern. The trap can be made of brass, nickel plated if desired, or cast in lead, and joined together by a mixture called earthenware solder, which easily makes a joint as safe and strong as the body of the basin, so that having a joint under water is now of no detriment. Fig. 3 is a common basin that has not sufficient area of watered surface to receive the droppings or keep the interior of the bowl clean. Fig. 5 is the simplest and most satisfactory sanitary closet of the four, but to connect this kind of closet to the soil-pipe in the way that it is manufactured and shown, the soil-pipe must be placed at the rear of the closet and the flush-pipe at the same place. This arrangement would in nearly all cases be very inconvenient, and make it hard to join other connections to the vertical soil-pipes. By Fig. 4 I show how any wash basin, bath, sink or set of wash-tubs should be connected, taking care to fix the short branches level, so that no pocket of air can accumulate between the fixture trap and the vertical soil-pipe. If by reason of the great distance between the fitting and the vertical waste-pipe, a perfectly level pipe is too long and would not work well, then another line of vertical pipe must be made that can be set nearer the fitting to accept the short branch. No line need be erected perfectly plumb from the foot to head, but may be bent to suit circumstances, on condition that a good upward grade is always obtained in every part, and all branches are inserted in the vertical portion and not into the graded portion. The reason for this will be obvious to mechanics.

A few years ago the improvement in drainage and plumbing took a wrong turn and large sums of money were being wasted by municipalities, causing the people at the present time to be slow to spend more money to undo the evils thus created. But there are other towns which would not reorganize their sanitary laws to comply with the new ideas because of the large expense it entailed, and the nuisance of the long delays and inspection, etc., required. Then some experienced sanitarians could not see the advantages stated by the promoters of the new system, only the one that would increase the cost and circulate money. These towns are fortunate, for the experiments lately made have not only proved the extreme folly of the obstructive system (which can easily be proved by watching the gases coming out of the street grates on a hard frosty day), but have found out how easy it is to arrange both sewers and plumbing so that no sewer gas can be manufactured in them, therefore the public could not be poisoned with it, and our private drains and main sewers may by using reasonable intelligence during construction be made as odorless as any other part of our inhabitable premises.

THE ETHICS OF CIVIL ENGINEERING.*

I do not intend to inflict upon you a long historical sketch of the engineering works which have been commenced or completed during the past year, for the daily papers with their well written articles and photographic accompaniments bring these matters attractively to our notice, and the technical journals record them with such close detail and elaborate drawings that they are in everyone's mind or on our book shelves as works of reference, far more valuable and with infinitely greater facility for reference than any words of mine would possess. A few words to the students and young members of our society may, however, be of some service, and, if devoid of any other merit, will, I promise you, possess the merit of brevity. With such institutions as McGill College, which the young man of to-day, especially those within easy reach of Montreal, possesses, he will be well equipped for, and should move forward erect and with a firm and steady step, indicative of his honesty and firmness of purpose. In due course he will no doubt secure an engagement on some public work (thanks to his McGill diploma), and his success will be in his own hands. He will probably be located in some small town or village, a stranger to everyone, and, if he has not already done so, he should formulate for his guidance rules of conduct based on common sense, which will win for him the confidence and respect of the community, which are as necessary for his advancement as technical knowledge. He should be cheerful and affable. He should move slowly in forming acquaintances, that he may not make mistakes which it would embarrass him to correct. He should not pose as a puritan, but should avoid saloons and gambling as he would the plague. He should be early in the field and late in the office when the necessities of work require. He should make it a point to have his work well laid out in advance and detailed plans prepared early, that the contractor may have no grounds to complain of delay on his part, for it is of the first importance that the contractor should have facilities for changing his men from place to place or putting on a large force when conditions are favorable. It may also affect the contractor's profits if plans of structures are not furnished at an early day, that he may arrange for materials when prices and conditions are in his favor. In preparing detailed plans, utility and durability should be studied. Standard sizes and shapes should be used as far as conditions will permit, as a departure from standards means not only increased cost, but difficulty and often serious delay in obtaining materials. He should cultivate the habit of observing closely what is being done upon the work, how and with what appliances it is being done, and who is doing it. He should make himself familiar with the roads and short cuts in the neighborhood of the work, and their varying conditions as affected by the weather and seasons. In short, he should be perfectly at home in everything connected with the work and its surroundings, that he may be eligible for advancement when opportunity offers. When measuring the work for the monthly estimates, he should, as far as time will permit of his doing so, return the actual quantities of work done and materials delivered, as it would be unfair to the contractor to underestimate the work, and an unkindness to him to over-estimate it, as to do so would be misleading and disappointing when actual quantities were returned, as they would eventually have to be. By assisting the contractor in the various ways above mentioned, it will be less difficult for the young engineer to say no when his duty requires him to do so, and that unpleasant duty will, no doubt, have to be occasionally performed, particularly about estimate time, when large estimates are often asked for by the contractor "to tide over pressing needs, and to be adjusted in the next month's estimate." Such a course should never be followed. The actual quantities should be returned to the senior engineer with the statement of facts. Young engineers beginning practice to-day have advantages which their seniors educated in this country have never had, and no more genuine and sincere assurance of the appreciation of the munificent donations which have made McGill College what it is can be given the donors than to see the lecture and experimental rooms and museums thronged with bright and earnest students making every possible effort to possess themselves of the wealth of knowledge so generously placed within their reach, and so easily acquired with the assistance of McGill's able professors. A thorough grounding in the fundamental principles of any profession or calling is as necessary for the individual independence and stability which every man should strive to possess, as a solid foundation is for the stability of a structure. This thorough grounding McGill College affords, with facilities which cannot be surpassed, and I would urge upon our students and young members to avail themselves of these advantages to the fullest extent possible. Theory and a large portion of practice, especially in the results obtainable from the testing machines, here go hand in hand, and the earnest and painstaking young engineer, almost at the commencement of his career, may be in possession of information which others have picked up like crumbs here and there in course of a lifetime, as failures of works or "accidents" have offered opportunities to careful students, for we are all students in engineering until the curtain falls in the last act of this existence. The college course, however, will soon come to an end, and the young engineer must start out to make his way in the world. If he is well grounded, as we will assume, has a McGill diploma in his pocket, his trust in Providence and his powder dry, at such a time the prudence of not accepting presents or having any money dealings with the contractor will be fully realized. He should carefully check the work in the field and in the office, remembering that, in addition to his duty to himself, he owes it to McGill College to maintain the standard which his diploma should give assurance of. He should be reticent about the work, excepting with his senior officer, to whom he should give a full measure of loyalty and carry out his instructions promptly and cheerfully. He should be free from prejudice and strictly fair. If he will observe these rules, and it needs but a little firmness and self-denial to do so, he will forge steadily ahead, as men of such character are always in demand.

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*Being the opening address of President W. G. McN. Thompson at the annual Convention of the Canadian Society of Civil Engineers.

—After a squabble lasting for years the contract for the elevators in Toronto's new city hall has been let to Leitch & Turnbull of Hamilton, at a figure much below the tender of the Fensom Co. of Toronto. After the contract was let the architect, as is his habit, found a few alterations necessary and it is said the figures for the plant will after all be about the same as the Fensom Co.'s price.

—At the last annual meeting of the American Public Health Association, at Ottawa, J. W. Hughes, Montreal, read a paper entitled, The Intercepting Trap in Private Sewers, in which he quoted very fully from the series of articles in The Canadian Engineer on that subject from the pen of W. M. Watson. In the published reports of the paper in this country, Mr. Hughes kindly credited the author and publication, but in the report published in the Surveyor and Municipal and County Engineer, London, Dec. 30th, 1898, we find, no doubt through inadvertence, no mention of an author other than Mr. Hughes, though the paragraphs quoted by the Surveyor are from the columns of The Canadian Engineer.

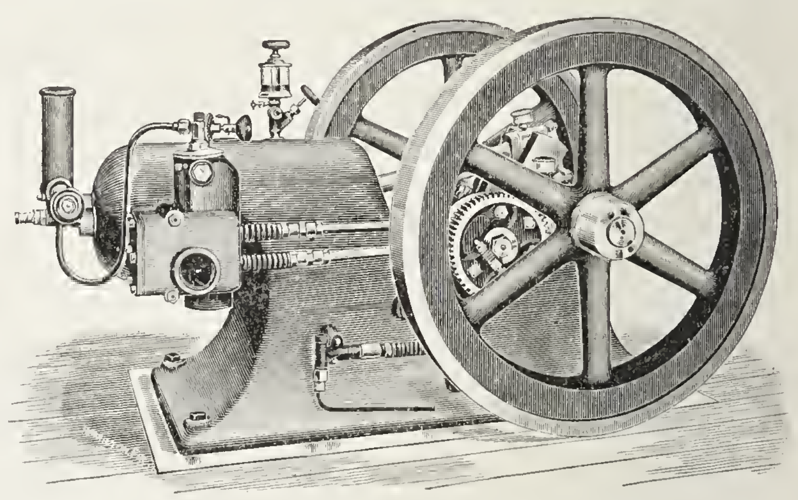
—The great solidity of the masonry of old Montreal buildings and of the fortification walls and other masonry throughout the province of Quebec generally, has been the admiration of engineers and the dismay of contractors who have occasionally had to dismantle these structures. A correspondent informs us that the secret of this great strength is that the French Canadian builders of old made a practice of seasoning their mortar by burying it in the earth over winter. The mortar was prepared in the autumn; a pit was dug below the frost line, the bottom being lined with sand and a wall of sand being put in the sides as the mortar was dumped in. The top was then also covered with sand and the bed covered deep enough with earth to keep away the frost.

THE QUEBEC BRIDGE.

The company proposing to construct the bridge at Quebec will open the tenders after March 1st. The story recently published in the daily press, and even repeated by some of the technical journals, to the effect that the Government was asking leading firms to tender, is of course untrue, and the Government has nothing to do with the matter. The bridge is in the hands of a company which hopes to receive aid, as has been promised, from the Dominion, Provincial, and municipal governments, but the company alone is in conduct of the business of the erection and maintenance of the structure. At present the cost of the structure is estimated at from 2½ to 3½ million of dollars for the bridge itself, the shore approaches probably costing another million.

THE MODEL GAS ENGINE.

A constant demand from users of small power for an efficient engine that could be handled with little expense and without the aid of an engineer, has brought into existence the gas and gasoline engine, and the makers of the Model Gas Engine unhesitatingly state their confidence in its ability to perform satisfactorily every requirement of the work it is calculated to do. The advantages of the Model Gas and Gasoline Engine are claimed to be many. We mention a few:—It can be run at trifling expense; no expense when not running; little floor space; no explosions; no danger; no smoke, dirt or noise; ready in five minutes; can be operated by a boy; can be run with either gas or gasoline. To start the Model Gas and Gasoline Engine, turn balance wheel a half turn forward, then a half turn backwards, and the engine starts. This is within the power of a fifteen year old boy, even if the engine is 12 horse-power. The Model is wonderfully simple. So few are its working parts that it seems almost incredible it should do its work so perfectly. There is not a lever, rod or working part of any description inside the bed plate, not even a cylinder head or water joint. There are no joints opening from the water jacket into the bore of the cylinder.



The "Model" takes the gasoline direct from a tank supplied by a pump. The gasoline tank is situated outside the building at any distance desired, and the gasoline is pumped to a small tank at the engine. This small tank is kept constantly full and has an overflow back to the large tank. We use the hot tube igniter in preference to the electric spark, as the latter is so hard to keep in order. However, the makers will furnish same if desired. The governor of the Model Gas and Gasoline Engine is of the type that regulates the supply of gasoline according to the amount of work being done, by shutting off the supply when the speed increases above the normal. The advantages of this over a graduated charge governor lie in the fact, the makers state, that if a small charge be admitted it will not explode and be thus wasted. The governor in use on the "Model," it is said, overcomes all these objections, and keeps the speed as regular as possible in a gas engine. The Model Gas and Gasoline Engine is made by The Goldie & McCulloch Co., Limited, Galt, Ont., who make any size, and give particulars of large sizes on application.

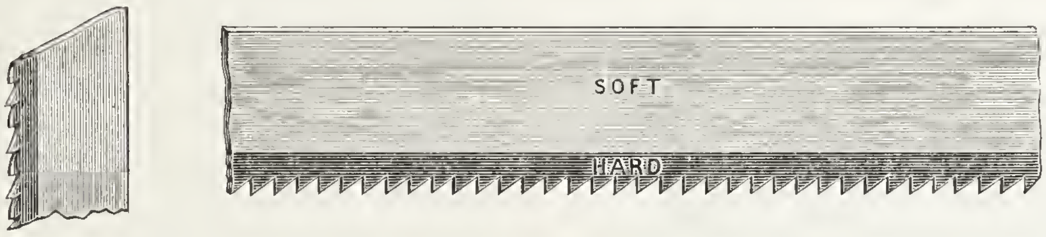
SAWS FOR CUTTING METALS.

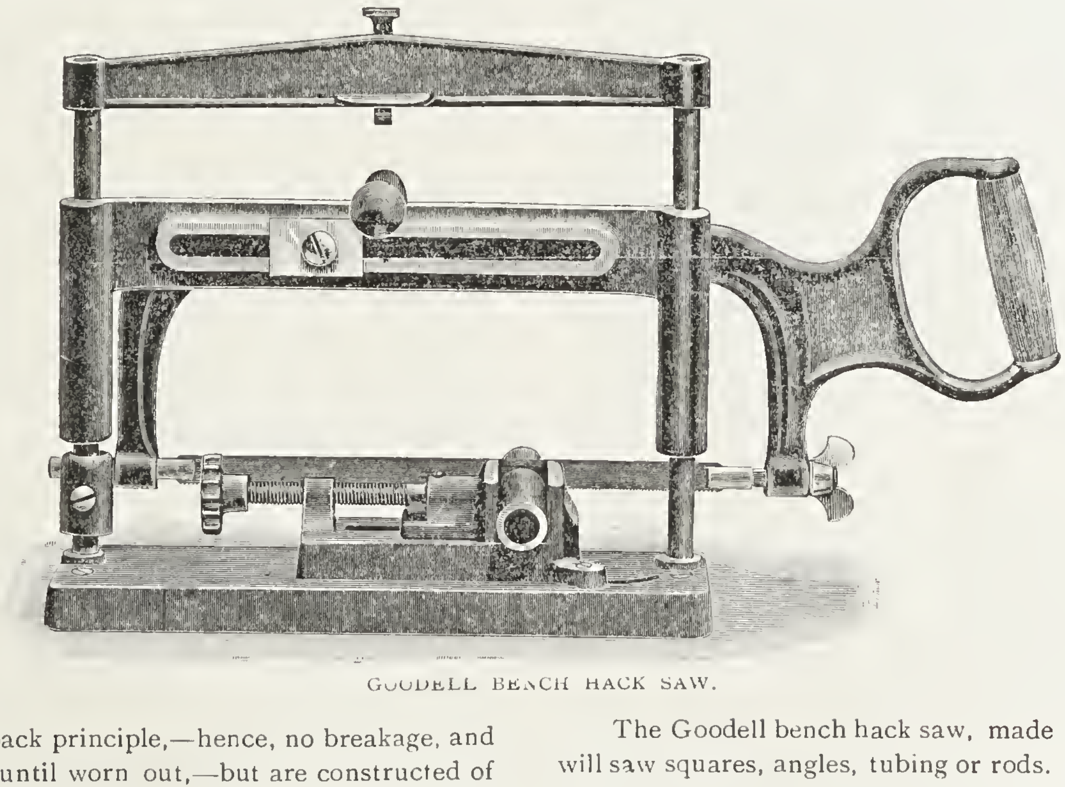
Comparatively speaking, it is not many years ago when the only saw known on the market for cutting metals was one in which the blade was made of steel drawn down to a spring temper, and hardened equally throughout, consequently the hardness of the teeth and back were the same. The result was:—1st: That the teeth having only the hardness of spring temper, could not cut any metal harder than itself; 2nd. When dulled by use, required to be re-sharpened by a file; 3rd: The blades were expensive, which precluded their universal use, in addition to their limited capacity. It was the custom in machine shops, when a piece of steel was to be cut, and especially hard tool steel, either to cut it in a lathe or planer, or send it out to the blacksmith to heat and cut; both these methods were expensive, but the latter had the additional disadvantage of deteriorating by heating in the forge, and its being returned in such a rough shape as to require additional machining. The advent of saws made on the flexible back principle, has changed the old system, and now it is a very rare occurrence when a blade equally tempered throughout is either found in a machine shop or, in fact, on the shelves of hardware dealers. The reason for this is, that by the flexible back principle (see cut) the teeth only are hard, the back remaining soft.

PAT. FLEXIBLE BACK HACK SAW

The advantages are: 1st. The hardness of the teeth being such that a file will not touch them, thereby enabling the Eureka flexible back hack saws to cut any metal a file will touch. It is an every-day occurrence its makers claim that the Eureka flexible back saws are cutting not only unannealed tool steel, but every metal and substance imaginable: 2nd. The back being soft prevents the saw from snapping or breaking in two; consequently the life of the saw is insured until it is absolutely worn out by use: 3rd. By improved methods of machinery, the Eureka flexible back hack saws are not only manufactured with an accuracy hitherto unattainable, but are put on the market at such an exceedingly low figure that when worn out they are thrown away, the labor and cost of files in re-sharpening being greater than the cost of a new saw.

In the old days any piece of steel with teeth on one edge was called a saw, and was used for every purpose up to its capacity, which, however, was very limited; but in these days of specialties, experience has taught that a saw blade should be made adaptable to the work, and not the work to the blade. By studying the requirements of different classes of workers in metals, the Eureka flexible back hack saws are made with especial objects in view, and therefore differ not only in the number of teeth to the inch, but also in temper or degrees of hardness. Another method of cutting metals, which has revolutionized old systems, is the use of the automatic power metal sawing machines. These machines use saws attached to an arm, having a reciprocating motion, and as they work automatically, when the work is put in the machine no further attention is required, and when the metal is cut through, the machine stops; a boy can run, and does in some factories, the makers assure us, a dozen machines. In many other cases a lathe or planer hand has sufficient time to run one or more automatic machines without detriment to his special work; hence the work of cutting the metal costs practically nothing in labor, besides effecting a saving in material over the old methods. The X L power saws have met with a widespread success in use in these machines, for the reason that they are not only made on the flexible back principle,—hence, no breakage, and assuring the life of the blade until worn out,—but are constructed of steel of heavy gauge, thereby preventing any bending or bowing of the blade and causing the blade to run straight. Although the automatic power sawing machines fill a long felt want, still their scope is limited to straight cutting. There remains a demand for a proper cutting instrument to cut irregular sizes, curves, metal sprews and castings, or any metal outside of straight cutting, in fact the scope of automatic power sawing machines is limited even in straight cutting; hence the success of the band metal sawing machine, for the reasons: 1st. It cuts continuously, there being no loss, as in reciprocating machines. 2nd. Its speed is very much greater, as the saw is driven in conformity with the hardness of the metal to be cut, hence the reason why a four-cone pulley is recommended for each band saw frame, thereby enabling the operator to cut the softest brass or the hardest unannealed tool steel on one machine.





GOODELL BENCH HACK SAW.

Heretofore band saws for cutting metals have been imported from France and Belgium, but these importations have practically ceased, it is said, for these reasons: 1st. They are made from spring-tempered steel, consequently cannot cut any substance harder than itself, i. e., cannot cut tool steel. 2nd. As they are made from steel, spring-tempered, so called, they are hardened throughout, thereby causing rapid crystallization, hence breakage; again, when dull, require filing, but on account of the crystallization above stated, the saw will admit of but few filings. These defects are overcome by the use of the Thompson flexible back band saws (see cut). The teeth are hard, harder than the metal to be cut, but the back is soft, thereby preventing crystallization. The saws are so inexpensive that they are never re-filed, in fact it would not pay to expend the time of labor and the cost of files in so doing.

The Thompson flexible back band saws, manufactured by the Henry G. Thompson & Son Co., New Haven, Conn., U.S.A., are not an experiment, but have been in use for a dozen years in cutting almost every conceivable substance, from onyx and pearl, down to the softest metals:—as iron, steel, brass, copper, bronze, sheet metal, tubing, sprews, pearl, onyx, etc., in fact any substance that a file will cut, by manufacturers of machinery, jewelry, dies, irregular shapes, scrolls, chandeliers, cornices, steel, roofing, stamped ware, cutlery, silverware, tubing, specialties, mica, slate, etc.

The tubing and sheet metal saw is made from steel 23 gauge, 30 teeth to the inch. It is designed expressly for cutting thin iron, steel, brass, and copper tubing, and sheet metals. The makers state it is just what is wanted by bicycle makers and repairers.

Those interested in this subject can obtain full information from Aikenhead Hardware Co., Toronto.

The Goodell bench hack saw, made by the Goodell Brothers Co., will saw squares, angles, tubing or rods. It is well made. The Aikenhead Hardware Co., Toronto, will give prices, etc.

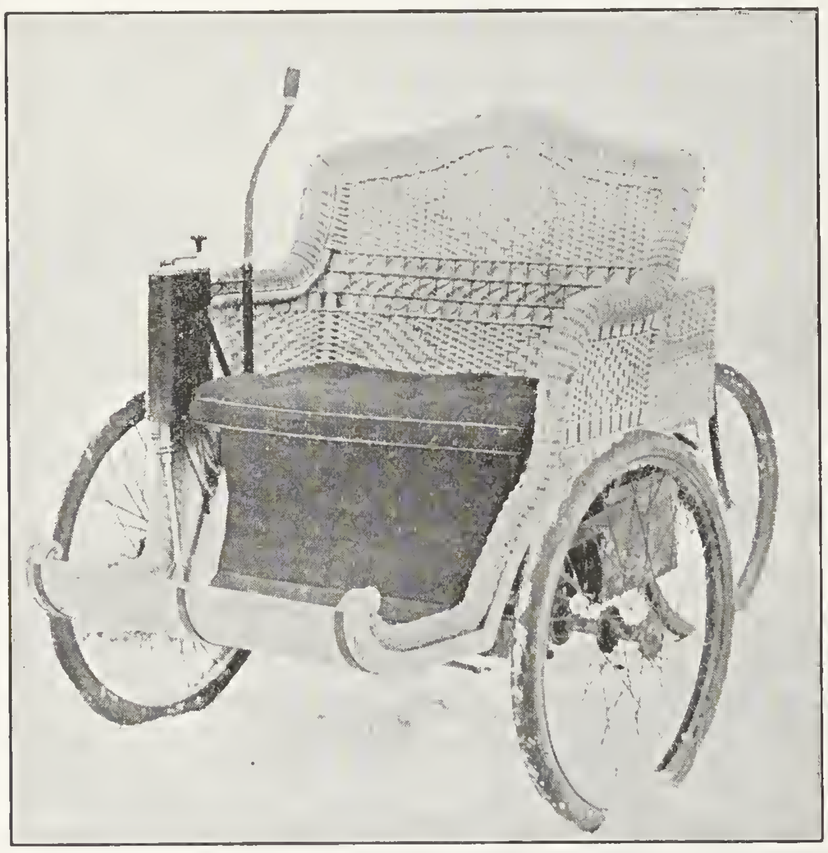
METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports of interest to the metal trades during December, 1897 and 1898, and the twelve months ending December, 1897 and 1898:—

	Month of December.		Year.	
	1897.	1898.	1897.	1898.
Hardware	£4,327	£1,549	£68,172	£25,717
Cutlery	..	9,677	..	116,850
Pig iron	225	42	9,447	11,322
Bar, etc.	263	1,653	8,892	13,315
Railroad	..	3,518	45,796	28,766
Hoops, sheets, etc.	112	1,664	77,954	64,893
Galvanized sheets	5,185	761	57,573	65,968
Tin plates	7,149	13,386	224,570	172,362
Cast, wrought, etc., iron	4,625	2,802	34,066	34,696
Old (for re-manufacture)	170	..	7,524	3,574
Steel	3,946	2,372	55,764	49,483
Lead	978	1,067	28,379	36,943
Tin, unwrought	3,356	1,003	21,021	18,272
Alkali	1,361	1,736	44,550	50,608
Cement	2,701	636	22,536	26,018

THE AUTOCAR INDUSTRY.

The chief feature of progress during the past month has been a Canadian production of novel construction and appearance which is illustrated on this page. A representative of The Canadian Engineer has had the pleasure of riding in this electric motet with the inventor of the battery and motet, W. J. Still, mechanical engineer of the Canadian Motor Syndicate, on whose design the carriage was constructed. The motor is slung over the front axle, and the two front wheels drive, while the hind wheel steers by means of the handle held in the left hand of the driver. In going over rough block pavements the effect of having the single wheel drawn over the roads from behind instead of pushed in front is very noticeable. In the ordinary tricycle construction, where the single wheel precedes, every depression and obstruction in the road produces a shock which is immediately felt, to the great discomfort of the occupant. In this electric motet it was noticeable that the block pavements, which on some of the streets traversed were very rough and full of deep ruts, did not materially affect the comfort of riding, the shock of contact being minimized by the two front wheels, and the dropping of the hind wheel into the depressions having no perceptible effect on the occupants. It starts and stops without any of the jerking which we have noticed in other autocars we have examined. The motet presents an unusual appearance which is pleasing to the eye, while the rattan body mounted on spiral springs, adds elegance as well as comfort to the vehicle. The absence of the conventional dashboard gives the rider a peculiar sensation at first, but as he is prepared for novelty this feature becomes only one of many contributing to the pleasurable sensation of a rapid run. The facility of movement is one of the strong features of this little vehicle, which turns in less space than a bicycle requires. It is equipped with the Still patent storage battery weighing 180 lbs., and has a range of 30 miles. By increasing this weight to 300 lbs. the range could be increased to 40 miles without recharging—a greater range than has yet been obtained by any electric carriage. It may be added that the cells with which this motet was equipped at the time of our ride were the old ones that had been used in the electric victoria formerly described in these columns, and which on account of an accident to that carriage had been idle for about eight weeks. Mr. Still stated that with an equipment of new cells made upon his latest type of construction he could secure a range of 40 miles with a battery weight of about 200 lbs. The cells can be charged from any circuit. The motor, also invented by Mr. Still, is of special design, giving great power, but details were not available for publication at this stage. At the reasonable price asked for the motet there should be a large and immediate sale for them. The construction of this beautiful and serviceable carriage opens a large field for various types of bodies, ranging from a light delivery vehicle consisting of a simple box with seat in front, to a miniature hansom with the driver seated in the rear of the box, the front being enclosed in glass, so that the view of the occupants would be entirely unobstructed. Such a carriage would be able to accomplish all that is now obtained by the large and cumbrous hansom cabs in London and New York, the total weight of which is 3,200 lbs.—eight times that of the Canadian electric motet. In spite of the smallness of this vehicle—or perhaps because of it—the motet carried Mr. Still and a passenger weighing 240 lbs.—a total load of nearly 500 lbs.—up hill on Avenue road, Toronto, a grade of 10 per cent Two motor carriages of other makers—one electric and one gasolene—failed to accomplish this feat. For city use, and even for professional men who have country practice, electric carriages are found to fully answer all demands, the investigations made by Col. Pope—who placed cyclometers on ordinary run-about conveyances of a number of private citizens, surgeons, expressmen, etc.—having shown an average mileage of 18 miles per day, and with one exception a maximum mileage not exceeding 25. Of course with a duplicate battery 100 miles per day could be made.



CANADIAN ELECTRIC MOTET.

Total weight, 400 lbs.; battery weight, 180 lbs. (Still Patent Battery); capacity, 2 persons and 50 lbs. of baggage, or, fitted for light delivery, 250 lbs. and driver; speed, 12 to 15 miles per hour; range (without recharging), 30 miles; steers by hind wheel, guided by left hand; steering handle lifted, as shown in photo, when occupant leaves seat; controller (in right hand) has four positions, reverse and brake; current used, 15 amperes on ordinary roads; power from special motor, designed by W. J. Still, giving 3½ h.p. for 70 lbs. weight; extreme length of wheel base, 4 feet; extreme width of wheel base, 4 feet; cost of running, ½c. per mile; turns in smaller space than a bicycle; price, f.o.b. Toronto, $400.

Since our last issue further details are to hand in reference to the exploitation of compressed air in New York, to which we referred in last issue. The following are the names of the companies already organized: American Air Power Company, capital $7,000,000, controlling works in New York city and compressed air street cars for United States; International Air Power Company, capital $7,000,000, with works at Worcester, Mass., and Providence, R.I., to sell compressed air auto-trucks, engines, locomotives and automobiles; New York Auto-Truck Company, capital $1,000,000, general truckmen, using International Air Power trucks, and owning charging stations throughout New York; Chicago Auto-Truck Company, capital $10,000,000, controlled by the Leiter-Hoadley Syndicate, the same business as New York Auto-Truck Company; Philadelphia Motor Wagon Co., capital $1,500,000, for manufacture of self propelled wagons and for vehicles, supposed to be connected with the Cramp-Hoadley Syndicate of New York; Philadelphia Auto-Truck Company, reported capital, $10,000,000. A certain air of mystery surrounds these companies, and although the newspapers are careful to state that "no stock is for sale," we predict that when the promoters think the time is ripe the stock will be put upon the market at a big premium. As proof of this we point to the fact that the stock of the New York Auto-Truck Company, which was listed at 9 in September, 1898, was sold at 48½ on January 14th, 1899, the day on which the present organization was completed; jumped to 62 on January 16th, to 68 on January 17th and on January 18th was quoted at 71. Mr. Knight, one of the inventors, in an interview stated that owing to pressure from large financial men he had been induced to increase the capital stock of the International Air Power Co. from $1,000,000 to $7,000,000. This explains why the stock jumped. Of the $7,000,000 capital above referred to, $6,400,000 represents property and $600,000 is to be put on the market as preferential stock with 3 per cent. cumulative dividend. The surplus over this $600,000 will represent profits made by the promoters.

With regard to compressed air vehicles, there is one point of considerable interest to all engineers who are watching this problem. We observe the power is stored in steel bottles charged with 4,000 lbs. to the square inch. This is considerably more than has ever been attempted before, and we notice that the tubes are only 5-16 inches thick. Of course there is no doubt that nickel-steel has a very high tensile strain, and it is just possible the bottles made of this substance may stand the test, as stated in the reports, of 1,8000 lbs. to the square inch, but there is a point worthy of very careful consideration as to whether these bottles will withstand the constant vibration they will experience on the road without very rapid crystallization of the steel. This would be especially likely to take place, suspended as these are upon the reach of the vehicle. This we think should be thoroughly tested before any such vehicles are put on our public streets, as the danger of explosion of such a bottle as this loaded to 4,000 lbs. to the square inch would be a severe menace to life and property. The destructive results of the rupture of one of these tubes would be much increased by the fact that with their fibers crystallized by constant jarring they would inevitably shatter to fragments, and the pieces would be scattered in all directions.

Considering the fact that the Hoadley-Knight compressed air car made but 15 miles upon steel rails with air reservoirs weighing 3,000 lbs., a very large amount of improvement will have to be produced before it is possible to drive compressed air vehicles over our ordinary thoroughfares for anything like reasonable distances, and we are extremely doubtful whether with the charging stations at one mile apart, as suggested by Hugh Dolner, the use of the storage battery would not be a preferred system.

Compressed Air, the monthly journal published in New York, contained in its issue of August, 1897, some correspondence which is of special interest just now. A correspondent having asked for information as to running a horseless carriage by compressed air, the editor replied as follows: "Compressed air as a motive power has many economical and useful applications, but it has its limitations. Our hope in this direction seems to be confined to the possibilities that might result from the use of liquid air. At present there does not seem to be much encouragement in the use of compressed air for motor carriages. The limited space obtainable and the weight of the apparatus seems prohibitive. A steel tube of one cubic foot capacity with air at 2,000 lbs. pressure (say 9 inches diameter) will contain 268 cubic feet free air, and power required to compress this quantity per minute will be 268 x .43-115 h.p.; or if done in one hour's time will be 2 h.p., and this calculation is based upon the very best type of 4-stage compressor with perfect intercoolers. A pair of 2½ inches x 5 inches single-acting cylinders operating at 100 lbs. pressure require each 32 cubic feet free air when running at best speed (say 400 revolutions per minute), so that out of a storage reservoir of 2 cubic feet, you will only get a run of about four minutes. The weight of a Mannesman steel tube 9 inches diameter, per cubic feet storage, is 82.2 lbs., and weight of 1 cubic foot air at 2,000 lbs., is 10.2 lbs., making a total weight of 92.4 lbs. for every 2 minutes the carriage will run." This reply must have been discouraging to the correspondent, for it would mean that a run of two hours would involve a weight of 5,544 lbs.! And the correspondent wanted to build a carriage on "bicycle lines." The editor's calculation, however, is evidently based on the assumption that the air is used without expansion. This practically is never done in modern compressed air engines. The result of the calculation, therefore, is scarcely fair to modern compressed air systems.

In opening its fourth yearly volume, The Autocar takes occasion to review the present position of the autocar industry throughout the world. The record of progress is interesting. In Britain a year ago there were less than fifty autocars; to-day English-built vehicles, both cycles and cars, may be numbered by the hundred, and with importations would total 500. The British output has trebled, being six vehicles per week. In France a twelvemonth ago the cars were counted by hundreds; now they are estimated by thousands. Germany is going steadily ahead; the United States is beginning to make up for lost ground; and Canada has entered the list of autocar manufacturers. The cab trials in June last brought electricity for the first time in competition with the gas engine, and, to the surprise of all who attended the trials, electricity carried everything before it as a power for the propulsion of public vehicles in large cities. The electric cab fulfilled all the conditions of the Paris companies, even to the question of working cost. The heavy autocar trials demonstrated that electricity must be taken into very serious account in the future for the driving of heavy vehicles, several of which are now running in Paris. The greatest advance in this class of vehicles has been the raising of steam with liquid fuel, and the Serpollet car has shown the possibility of applying this power under conditions where steam has not hitherto been practicable. A good many heavy vehicles have been sent to North Africa, Senegal and other countries. In France, also, steam road traction has undergone an extension, and several new lines of steam cars have been inaugurated during the year.

Our critical comments last month on the reported "fifteen million dollar deal" in autocars by Count Jotemps of Paris, have been fully justified by the facts which have since come to light The sum and substance of the matter is simply this: Count Jotemps, whose wife is an American, took a tour of the motor carriage factories, with the following result: He secured the agency for the Stanley steam carriage in France and Belgium; ordered three carriages from Holyoke Motor Works, contracting to take 50 vehicles during the coming season; did nothing with the Overman Wheel Co., whose carriage was not ready to show; and he arranged with the Fischer Equipment Co., of Chicago, for 100 carriages per year for ten years. Total business, about a million dollars extending over ten years.

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The seventh annual meeting of Ontario Land Surveyors (fourteenth annual meeting of organized Land Surveyors of the Province) will open on the 28th February at the Parliament buildings, and will occupy three days. One of the chief items of business for the Association will be the discussion of revised by-laws for ratification. The programme is as yet by no means complete, but the following papers are expected:—Exploration Surveys, by James Dickson, Fenelon Falls; Survey Act, by P. S. Gibson, Willowdale; Survey of the Boundary between Nipissing and Algoma Districts, A Niven, Haliburton; Azimuth, S. B. Stewart, Toronto; Railway Location Survey, J. D. Evans, Trenton; Permanent Way, W. E. McMullen, St. John, N.B.; Dominion Lands Surveys, C. F. Aylesworth, jr., Madoc; A Railway to James' Bay, Villiers Sankey, Toronto; A Trip to Yukon and Return, Lewis Bolton, Listowel; Surveying and Surveyors, Jos. Cozens, Sault Ste. Marie; Evidence, by M. J. Butler, Napanee; Lake Wawanosh Drainage Scheme, J. H. Jones, Sarnia; Impressions in the Rocky Mountains, B. J. Saunders, Brockville; Forestry and its Relation to Flood Prevention, Thos. Southworth, Toronto; Drains of Field Tile, W. F. Van Buskirk, Stratford; Highway Culverts and Bridges, A. W. Campbell, Toronto. Papers are also expected from H. J. Bowman, Berlin; G. A. Mountain, Ottawa; C. A. Jones, Petrolea, and others.

STONE WORK CLEANING BY SAND BLAST.

Editor CANADIAN ENGINEER.

SIR,—In your issue for December, 1897, page 238, I notice an enquiry for "washing and whitening stone walls," from W. P. M., of Halifax, N.S., but in your reply thereto you have overlooked a method which has, I believe, been successfully used in both the United States and England. It is the employment of the now well-known "sand blast," the current of sand being projected against the face of the building from a hose supplied with air under pressure from any convenient source. This current of air-driven sand effectually cleans all dirt, etc., from the face of the stone and leaves it clean as if fresh from the tool, while it also has this great advantage that it can be applied without injury to carved work, thus saving the great expense of recutting same. It is curious and instructive to remember that the use of "sand blast" was suggested to Gen. Tilgman, who was the first to make commercial use of it, by his observance of the sharp wearing away of the stone of which the Pyramids and Sphinx in Egypt are composed by the sand driven against them by the winds of the desert. In many parts of the East of England, where there is a sandy tract bordering the sea, the window glass will be seen to be ground by the same agency and appears like frosted glass.

When in England last year I noticed enquiries for cheap doors and sashes and wood pulp—both kinds. Possibly you might be able to give pointers on these matters to your subscribers. Yours,

Toronto, Jan. 28th, 1899. H. E. KYLE.

THE PRACTICAL MAN.

To Soften Cast Iron for Drilling.—Heat to a cherry-red, having it lie level in the fire. Then with tongs, put on a piece of brimstone, a little less in size than the hole is to be. This softens the iron entirely through. Let it lie in the fire until slightly cooled, when it is ready to drill.

To Soften Steel.—Cover it over with tallow, heat it to a cherry-red in a clear coal fire and let it cool of itself.

Tinning Surfaces.—Articles of brass or copper boiled in a solution of stannate of potassa mixed with turnings or scraps of tin, in a few moments become covered with a firmly attached layer of fine tin. A similar effect is produced by boiling the articles with tin turnings or scraps and caustic alkali, or cream of tartar. In either way, articles made of copper or brass may be easily and perfectly tinned.

Varnish on joints is better than the average red lead.

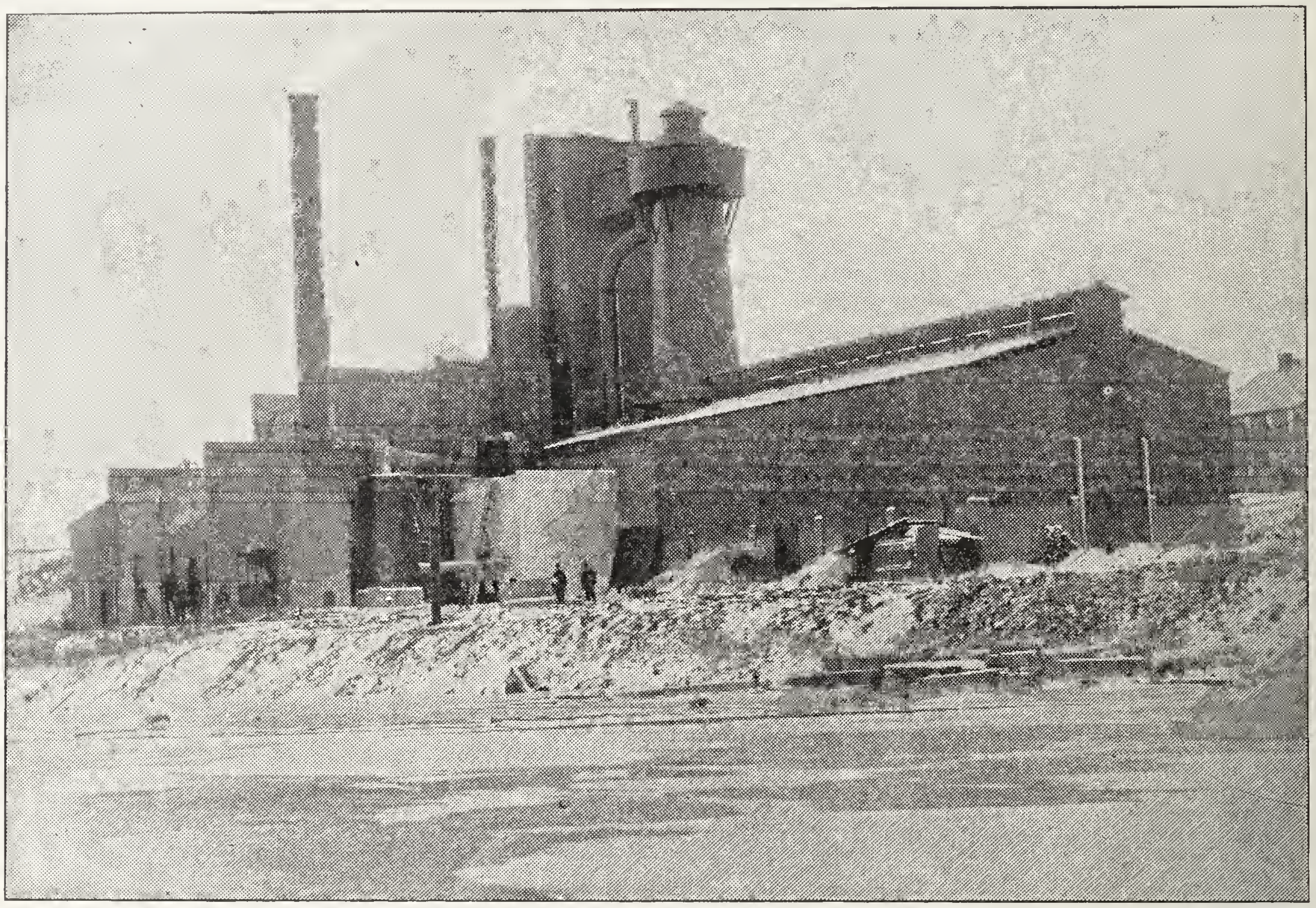
To Restore Burnt Steel and Improve Poor Steel.—Borax, 3 ozs.; sal ammoniac, 8 ozs.; prussiate of potash, 3 ozs.; blue clay, 2 ozs.; rosin, 1½ lbs.; water, 1 gill; alcohol, 1 gill. Put all over a slow fire, let it simmer until it dries to a powder. Heat the steel not above a cherry-red, dip into this powder and afterward hammer.

Rosin on the blacksmith's forge improves and toughens steel. When the tool is hot dip it into the rosin, then hammer.

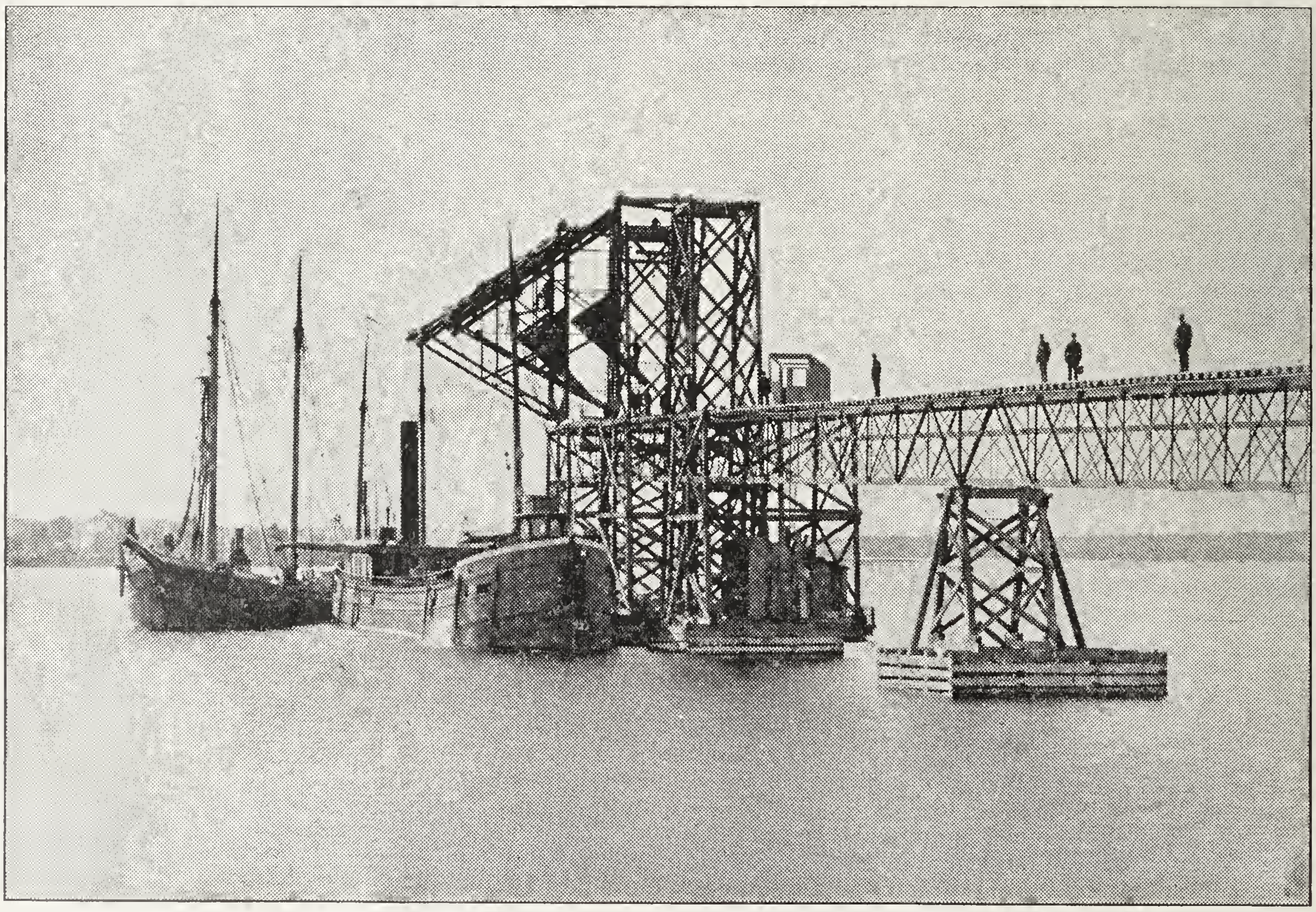
To Copper the Surface of Iron or Steel Wire.—Have the wire perfectly clean, then wash with the following solution, when it will present at once a coppered surface: Rain water, three pounds sulphate of copper, one pound.

THE DESERONTO IRON CO.

The manufacture of charcoal iron was begun by the Deseronto Iron Co., at Deseronto, Ont., on Jan. 25th, 1899, as reported in the Deseronto Tribune. The manufacture of charcoal iron, although for many years carried on extensively in various parts of the United States, has never attained large proportions in Canada. The only plant in active operation is that at Radnor Forges, in Quebec. Many years ago smelting works on a small scale were started at Marmora and in Algoma in Ontaro, and there was also a small plant near Woodstock, N.B. At that time the market for such iron was comparatively limited in Canada and there were other obstacles which discouraged the promoters. The undertaking at Marmora has revived several times, but the promoters met with severe losses and were obliged to abandon it. Although Canada has such vast areas of wooded lands and though in many parts of the country there are extensive deposits of iron ore, it is somewhat surprising that capitalists, during the past twenty years, have so little directed their attention to the smelting of iron by means of charcoal. The iron thus produced is almost indispensable in several lines of manufacturing and there is a market for it in Europe as well as on this continent.



The Deseronto Iron Co.—Main Building and Furnace—View from the Bay.



The Deseronto Iron Co.—The Ore Dock and Trestle.

The location of the new charcoal iron smelting plant at Deseronto, Ont., is primarily the result of a plan formed by the late H. B. Rathbun, founder of Deseronto, and his sons, E. W. Rathbun and the late F. S, Rathbun. They early conceived the idea of turning to account the waste material of their saw mills, and founded several factories with that end in view. To this end gas works for the conversion of sawdust into gas were started. The town was illuminated in this way for one year, but it was found to be unprofitable and afterwards the manufacture of fire proofing terra cotta was entered upon. Wood distillation was, after a number of costly experiments, made a success, and has been carried on for several years, the charcoal being exported to Detroit for the smelting works in that city. E. W. Rathbun, general manager of the Rathbun Company, entered into negotiations with the Gaylord Iron Company, Detroit, and other United States' capitalists, and after some years succeeded in enlisting their active co-operation. The wood distillation plant of the Standard Chemical Co., which was described in a recent issue of THE CANADIAN ENGINEER, will produce the necessary charcoal for the smelter. Even at the present contemplated output of 12,000 tons of iron per annum, the wood distillation plant, in order to furnish the necessary charcoal for the smelting, will require annually about 20,000 cords of coarse timber. The supplying of this material will furnish employment, during the cold weather, to at least 200 men and 80 teams of horses. In addition to these are the hands employed in the transportation of this wood by water and rail. The works are situated in the west end of the town south of Main street and directly on the shore of the Bay of Quinte. The line of the Bay of Quinte Railway has been extended to the works, thus giving connection by rail and water. The ore dock has three hoists for lifting the ore from the holds of vessels, and with a trestle and tramway for carrying the ore to the piling ground adjoining the furnace. The accompanying cut will give the reader a good idea of the dock and trestle. The works cover an area of four acres of ground.

The plant and works were erected under the supervision of M. C. Furstenau, C.E., Detroit. F. B. Gaylord is general manager of the Deseronto Iron Co. Miss Sherwood is assayer and chemist. Felix de Claqui is the engineer, and Stephen Fallon founder.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS

Toronto C.A.S.E., No. 1, met Feb. 1. A committee was appointed to look after the interests of those applying for the situation of engineer at the new Toronto municipal buildings. The following resolution was passed: "That the members of Toronto No. 1, C.A.S.E., deeply deplore the loss of life and personal injury to the innocent victims who suffered at the recent boiler explosion at the ice house in the east end of the city; and as a body of engineers wish to place ourselves upon record as concurring with the verdict of the coroner's jury which clearly set out the fact that the man in charge was incompetent; and that all boilers should be under the charge of practical engineers who have certificates, and that each boiler be inspected yearly by some competent person."

The annual At-Home of Toronto No. 1, C.A.S.E., will be held on Wednesday, Feb. 15th. A fine programme has been prepared and anyone going will be assured of a good time.

At the regular meeting of Hamilton No. 2, Jan. 3rd, after the formal part of the proceedings, the question box was opened and the "Vacuum" discussed. Much gratification was expressed at the election of Ald. R. C. Pettigrew, who headed the polls at the January elections and is one of the hardest working members of Hamilton No. 2.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

ANNUAL MEETING IN MONTREAL.

The thirteenth annual meeting of the Canadian Society of Civil Engineers was held at the society's rooms, 112 Mansfield Street, Montreal, opening on the 10th and closing on the 13th of last month. The attendance was unusually good and the convention, taking all its features together, was the best in the history of the society.

Among those present, on one or more days of the convention, were the following: K. W. Blackwell, Prof. C. H. McLeod, William McNab, H. Irwin. J. G. G. Kerry, Prof. John T. Nicholson, Dean Bovey, E. P. Hannaford, J. H. Parent, William Kennedy, Junior, Geo. Holland, E. A. Rhys-Roberts, M. Perrault, O. Arcand, L. A. Amos, F. P. Shearwood, W. C. Thompson, A. Massey, J. M. McCarthy, L. B. Copeland, J. H. Walters, J. S. Vindin, T. W. Lesage, G. H. Duggan, Stuart Howard, Ernest Marceau, W. McLea Walbank, Joseph W. Heckman, N. Hanson Greene, W. J. Sproule, F. C. Laberge, L. J. Marion, C. R. Coutlée, C. de B. Leprohon, Chas. S. Leach, H. Y. Bertrand, G. Legrand, W. A. Sanders, Duncan McPherson, A. Dedman, A. J. Bachand, L. S. Pariseau, Lewis Skaife, Frank S. St. George, L. G. Papineau, J. A. U. Beaudry, Dr. J. B. Porter, A. J. Corriveau, G. H. Garden, G. L. Mattice, Carl Reinhardt, L. F. Gagnon, L. A. Dufresne, James Ewing, J. G. MacGregor, J. P. B. Casgrain, R. W. Leonard, all of Montreal; W. T. Jennings, Willis Chipman, E. H. Keating, C. H. Rust, Henry A. Gray, Henry J. Duck, F. L. Somerville, H. Lindsay of Toronto; J. W. Fraser, A. St. Laurent, F. W. Cowie, Robt. Surtees, J. T. Farmer, Wm. Crawford, A. H. Bruce, G. A. Mountain, W. B. Anderson, G. H. Pinhey, of Ottawa; Henry O'Sullivan, Owen O'Sullivan, Thomas Breen, L. A. Vallee, Charles Baillairge, F. X. Berlinguet, of Quebec; R. Adams Davy and G. J. Desbarats of Iroquois; Thomas Monro, Coteau Landing; F. G. Butler, Napanee Mills; C. H. Ellacott, Westmount; B. J. Saunders, Ft. William; F. P. Strickland, Sydney, N.S.W.; J. S. Armstrong, St. John, N.B.; H. T. Hazen, Ste. Anne de Bellevue; R. and W. Russell, Pembroke; Rich. T. Gough, Halifax, N. S.; J. S. Bertrand, Fraserville; Wm. Burns, Renfrew; G. K. Addie, Sherbrooke; R. B. Rogers and W. J. Francis, Peterboro; M. J. Butler, Deseronto; E. G. Matheson, Charlottetown, P.E.I.; Geo. A. McCarthy, Moncton; N. E. Brooks, Calgary; J. D. Barnett, Stratford; Henry Zlapka, Hamilton; Prof. W. R. Butler, Kingston; Armitage Rhodes, Quebec; Geo. E. Thomas, Chicago; E. Berryman, Winnipeg; P. S. Hildreth, of R. W. Hildreth & Co., New York; Kenneth Moodie, Chicago; C. H. Osler, F. G. B. Allan, Napanee Mills.

The chair was occupied by K. W. Blackwell, vice-president, who calling the meeting to order, read a letter from W. G. N. Thompson, the president, regretting his inability to attend, owing to the illness of members of his staff.

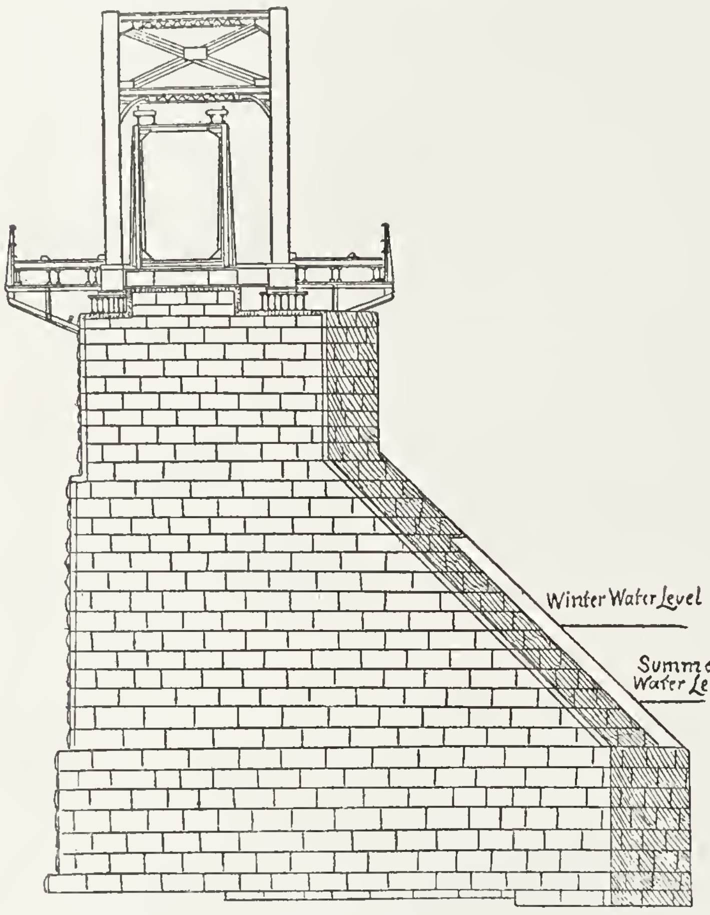
The secretary, Prof. C. H. McLeod, read the programme of the meeting and then read the minutes of the last annual meeting, which were confirmed.

Messrs. F. W. Cowie, L. Skaife and Frank St. George were appointed scrutineers of the ballot for the election of officers and members of the Council; while Messrs. J. W. Heckman, C. de B. Leprohon and Geo. A. McCarthy were appointed scrutineers for the Nominating Committee.

The chairman announced that the Grand Trunk Railway Company had extended an invitation to the members to visit the new Victoria Jubilee Bridge, and that a special train would await the party at Bonaventure Station at 2 o'clock. The meeting then adjourned and in the afternoon a large party took advantage of the Grand Trunk's courteous offer. The day was very cold and a keen wind swept across the river, raising wreaths of steam over the only unfrozen spot in the St. Lawrence, just at the big central span, where the party halted. General admiration was expressed at the excellence of the bridge-work and masonry, and the skill that had been shown in surmounting the special problems of construction presented in replacing the former tubular structure by this famous bridge. After inspecting the features of the great central span the visitors were taken to the St. Lambert end, so that on their return they could admire the approach to the city from the bridge. They were highly pleased with the trip, notwithstanding the zero temperature of the day. Joseph Hobson, Chief Engineer of the Bridge and of the Grand Trunk Railway System, acompanied the party, and explained many important details of the works.

The evening was pleasantly and profitably taken up with a general description of the Bridge, by Wm. McNab, Librarian of the Society, and assistant engineer of the Grand Trunk Railway System. The chairman first announced that a detailed account of the new bridge was being prepared by Joseph Hobson, Chief Engineer, and this description would be incorporated with the Society's Transactions of the current year.

The rooms were crowded, a large number of ladies being present, and Mr. McNab's address, aided by the stereopticon, in charge of F. R. Redpath, was most instructive. In beginning his description Mr. McNab remarked that no bridge of that period attracted as much attention throughout the world, or commanded as much admiration as the Victoria Tubular Bridge at Montreal which was erected between the years 1854 and 1859. When it was recollected that there were few precedents for the engineers to go upon in regard to many important matters, and that some of the difficulties to be overcome were here presented for the first time, and on such a great scale, we are bound even now to acknowledge the foresight and skill displayed by its designers and builders. The Victoria Bridge consists of 24 spans, varying from 242 feet to 248 feet in length, in the clear, and a centre span of 330 feet in the clear. The capacity of the old bridge was thought ample for all the traffic that would ever pass over it, and certainly no one could have thought that within thirty-eight years from its completion they would need the double track structure which the traffic of the present day requires. The engineer at that time had difficulty in making up a train weighing one ton per lineal foot, and to do it he had to put on three locomotives, and a specially loaded train. The new bridge is designed to carry a moving load in either direction, on each of the two tracks, consisting of two consolidation engines and tenders, followed by a uniformly distributed load, weighing 4,000 lbs. per lineal foot; also a moving load in either direction on each of the extended roadways of 1,300 lbs. per lineal foot. In the new structure provision is made for two tracks, which may be used both for steam traffic and for electric railways, and a vehicle and a foot passenger roadway is provided on each side, outside of the main trusses, formed by an extension of the great floor beams. This is shown in the accompanying diagram. So liberal had the original engineers been in the design of the capacity of the piers, that none of the foundations had to be extended, or even touched. All that was required was the extension of the masonry on the upper ends of each pier, by building up over the saddle of the cut water. This extension was about seven feet, and as there was no place below to pile the stone, the material for this addition had to be let down by a traveler working on top of the old tube. Each course of masonry was exactly the same thickness as the course in the old piers, of which it formed an extension, and each joint was made to overlap that on each course next below by twelve inches. The stones of each course were clamped together by clamps turned down 2½ inches, and embedded in the stone, there being both vertical and horizontal clamps. The stones were set in the most approved manner, and the pointing and grouting received the best treatment. Mr. McNab gave an interesting explanation of each picture thrown on the screen, showing the method of carrying out the pier beams and floor beams, the erection trusses, the method of placing the temporary cantilever spans to connect with the centre erection truss used on the big centre span; but as these will be described in detail in Mr. Hobson's forthcoming paper, they are not fully described here. For the building of the steel superstructure a sorting yard was laid out at each end of the bridge and the various bridge members were piled in the order in which they were to be used, the heavy members being placed under the great traveling crane, and the lighter ones outside the track, and handled by its cantilever arms. As the traffic had to be maintained while rebuilding, and false works in the river were out of the question, the idea of the traveling erection truss was adopted. These trusses, of which there was one on each side of the centre, were of the exact length of the small spans of the bridge, and were a little greater in width than the old tube, and a little less than the permanent truss of the new bridge. The pier beams were placed in sets of seven, one set on each side of the tube, and were lowered to place by means of a hoisting engine. Each set weighed seven tons. After the pier beams were placed, the end floor beams were riveted to them by web connections, and thus bound this part of the work both transversely and longitudinally, and distributed the weight uniformly over the piers.



The Jubilee Victoria Bridge—Pier and Section of Span.

The erection truss was traveled from pier to pier by means of a series of trucks moving on the rails or top of the tubes. Wooden blocking was placed on these trucks to carry the truss by means of its top members, and the wheels were so placed as to distribute the weight as uniformly as possible in passing over the tube, and it really strained the old tube less thon did the ordinary train traffic. The truss was drawn across each span by means of block and tackle, worked by a stationary engine securely placed on top of the next tube.

As instances of how perfect the arrangements were for the moving of the temporary truss, it may be stated that the time occupied in the actual passage from pier to pier, was only from 4 to 6 minutes. After the truss had been placed exactly over its bearings on the piers, it was lowered in place, and the entire weight removed from the tube. The aggregate time for each span connected with the moving of the temporary truss and lowering it to its bearings, was only about half an hour. One erecting truss worked from each end towards the central span, upon reaching which the central erection truss was formed by the two trusses on an ingenious modification of the cantilever principle. From the 23rd March to 19th August, twenty-four spans were assembled and put in position. In removing the old tube, the body was removed in sections small enough (about 7 ft. x 18 ft.) to be handled and placed on the cars, and disposed of so as not to interrupt the daily traffic.

Pneumatic chisels were used to take the heads off of the rivets, and pneumatic hammers for backing the rivets out. In removing some of the bottom pieces a rail saw was used. The spans were adjusted to permanent level by hydraulic jacks of commensurate capacity. Mr. McNab's instructive sketch closed with pictures of the end view and a general view of the magnificent structure as it now appears.

The lecture was heartily applauded, and at its conclusion, E. H. Keating, of Toronto, proposed a vote of thanks to Mr. McNab. Mr. Keating said he was intensely interested in this great work, which was formerly reckoned one of the wonders of the world, and if it was so regarded then, what would its designers think of the remarkable work of its present reconstruction, in which problems then considered insoluble were carried out. Great credit was due to the engineers who designed it and the contractors who carried it out.

Charles Baillairge, of Quebec, warmly seconded the motion and said he had been greatly impressed, on their visit this afternoon with the beautiful outlines of the bridge, as well as its great strength and solidity. A heavy train passed along while he stood on the bridge, but hardly the least tremor could be felt. There were other great bridges in the world such as the Forth, the Menai and Brooklyn bridges, but in some respects, the Victoria was still the greatest structure of the kind in the world.

On motion of J. D. Barnett, of Stratford, a vote of thanks was also passed to Mr. Redpath for his good management of the lantern slides.

Prof. Bovey took occasion to refer to the great skill shown by Mr. Hobson in connection with this and other engineering works carried out for the Grand Trunk, and he regarded the present structure as one of the engineering triumphs of the Jubilee reign of Queen Victoria. He then gave a general invitation to the visiting members of the society to inspect the applied science departments of McGill University.

An interesting fact connected with the visit to the bridge was that John Duckworth, whom they all had met on the bridge that afternoon, had been inspector of the old tubular bridge since it was originally opened for traffic, and he it was who handled the implement which held the last rivet whilst the Prince of Wales drove it "home," at the inauguration of the bridge in 1860.

After partaking of light refreshments in the adjoining rooms the first day's proceedings closed.

WEDNESDAY, JAN. 11TH.

This day was very pleasantly taken up by an excursion to the works of the Laurentide Pulp Co. at Grand' Mère. Sir William Van-Horne, who is president of the company, had a train of parlor cars placed at the service of the society for the day, and the large turn-out of the members showed that the courtesy was fully appreciated. The five cars were quite filled when a contingent from Quebec joined the party at Three Rivers. The train left Montreal about 8.30 a.m., arriving at Grand' Mère about 12.30. On alighting they were met by Russell A. Alger, Jr., son of the Hon. Russell A. Alger, and secretary of the company, who with H. Meurer, manager of construction, and other officers of the company, showed the visitors over the great works which have created around them a town of 3,000 where there was only a hamlet when the mills began operations. When the falls from which the great water power is derived were visited by the French settlers, the contour of the projecting rocks showed the profile of an old woman hence the name it acquired of Grand' Mère (grandmother). This rock was blasted away in forming the dam, but the name still survives, maintaining the natural relation between grandmother and dam. The falls are capable of yielding 70,000 h.p. at low water and 90,000 h.p. at high water. About eight hundred hands are employed in these mills, besides 1,400 outside who are engaged in getting out the wood from the forest. The pulp wood pile at the mills covers more than an acre, and in some places is piled to the height of 30 or 40 ft., making about 80,000,000 of lumber measurement. These mills produce paper, card-board and pulp for export, and the daily capacity of the three departments is as follows — 40 tons of paper, 35 tons of cardboard, 110 tons of mechanical fiber (pulp), and 70 tons of sulphite fiber. There are 30 pulp grinders, three digesters, 45 ft. in height by 14 ft. diameter, one 112-inch Fourdrinier machine, one 90-inch machine and one board machine. In total capacity it is the largest mill in Canada, and one of the large paper and pulp mills of the world. After showing the party through each department the management of the mill invited their visitors to a luncheon served on improvised tables with big sheets of card-board for tablecloths, and heaped with huge turkeys, hams, ribs of beef and the kind of accompaniments which were most appreciated on a cold day. From the appearance of the tables after the lunch was over the managers could have had no doubt of the enjoyment of their guests. After thanking their hosts the party returned to the train and arrived in Montreal about 9 p.m.

Among the members and friends attending the excursion whose names have not been already mentioned were the following: R. C. Alexander, H. B. Sims, W. F. Angus, J. Ewing, J. W. Brock, J. F. Ellis, J. A. Burnette, R. Kenrick, R. F. Gough, A. Burnette, B. A. Davis, W. M. Young, J. C. Denis, R. S. Lea, E. G. Coker, J. P. B. Casgrain, J. H Larmonth, E. A. Stone, S. H. Capper, G. Taylor, H. R. Ives, and J. T. Shearer.

THURSDAY, JAN. 12TH.

The meeting was called to order at 10.30 a.m., the chair being taken by G. H. Duggan, who called on Thomas Monro to read his paper on "The Soulanges Canal," which, with the discussion on it, will appear in another issue.

At the afternoon session, when J. D. Barnett presided, a paper on the Trent Valley Canal was read by R. B. Rogers, engineer-in-charge of that work. A summary of this paper will be given in a later issue.

In the absence of H. K. Wicksteed, the chairman called on G. A. Mountain to read that gentleman's paper on the Georgian Bay and Ottawa Ship Canal, which is summarized in another part of this issue.

In moving a vote of thanks Ernest Marceau expressed the hope that this great scheme would be carried out at no distant date.

In seconding the motion, which was carried, J. S. Armstrong said he looked upon it as a work of great importance to Canada at large and to Montreal in particular.

FRIDAY, JAN. 13TH.

At the morning session the chair was occupied by Mr. Blackwell.

The secretary read the report of council for the past year, of which the following is a summary.

During the year eight members, twenty-one associate members, two associates, and twenty-two students were elected. Three associate members have been transferred to the class of member, and eight students to the class of associate member. One associate member and one student, removed from the roll for non-payment of dues, have been re-instated upon payment of their arrears. The elections under the Quebec Act, Vic. 61, Chap. 32, comprised four members, fifty associate members, and one student. Five students were admitted as associate members under the Quebec Act. Resignations have been received from two members, two associate members, one associate, and one student. The deaths have been: Of Honorary Members—Sir John Fowler, Bart., K.C.M.G., LL.D.; of Members—Col. Sir C. S. Gzowski, A.D.C., K C.M.G.; William Kingsford, LL.D., and Joseph DeGurse.

At present the membership stands as follows:—Honorary Members, 7; Members, 294; Associate Members, 232; Associates, 41; Students, 142; Total, 716. At the same date last year the total membership was 628.

Eighty-seven applications for admission into the society are now pending, against nine at date of last annual meeting. The Act concerning Civil Engineers in the Province of Quebec became law on Jan. 8th, 1898. This Act is known as Vict. 61, Chap. 32, of the Statutes of the Province of Quebec. No further Legislative enactments have at this date been obtained. In the Province of Nova Scotia an Act was brought before the Provincial Legislature during its last session, but, owing to local conditions, was not passed. In the Province of Ontario several conferences have been held with the Ontario Land Surveyors, and the Provincial Committee has drafted a bill based upon the Quebec Act and corresponding to it in essential features, which it is hoped will meet with the approval of the Government and become law during the next session. The committees in charge of legislation are as follows:— Central Committee.— P. W. St. George, W. J. Sproule, H. Irwin and C. H. McLeod.

Nova Scotia.—M. Murphy, C. E. W. Dodwell, W. G. Matheson and H. S. Poole.

New Brunswick.—Hurd Peters, P. S. Archibald and H. R. Lordly.

Quebec.—St. George Boswell, L. A. Vallée, E. Marceau, T. Breen and J. M. McCarthy.

Ontario.—W. Chipman, A. L. Hertzberg, M. J. Butler, E. H. Keating and C. H. Rust.

Manitoba.—H. N. Ruttan, G. H. Webster and J. Woodman.

N. W. Territories.—W. D. Barclay, G. A. Stewart and W. T. Thompson.

British Columbia.—H. J. Cambie, A. J. Hill, H. Abbott, F. C. Gamble and E. A. Wilmot.

The Council desires to point out that hereafter, all persons desirous of practising as Civil Engineers in the province of Quebec should become members of the society under the provisions of the Quebec Act, *i.e.*, they should pass the examinations therein prescribed and otherwise conform to the requirements of the Act. In accordance with the requirements of the Act a Board of Examiners has been constituted as follows: E. Marceau, R. J. Durley, T. Breen, C. H. McLeod, R. S. Lea and Prof. F. S. Duval. No examinations have yet been conducted, as no candidates have applied for admission except under Articles 2 and 3, which provided for practising engineers and land surveyors joining during the year 1898. This avenue of access to the society is now closed, except as regards provincial land surveyors, who were practising at the time of the passing of the Act.

An employment registry is now kept in the Society's rooms for the benefit of members. The president and secretary of the Institution of Civil Engineers extend a welcome to their institute to members of the Canadian Society who may be visiting the next World's Fair in Paris. Reference was made to the death of Sir Casimir Gzowski, who was founder of the only medal in the gift of the Society. Attention was called to the fact that the by-law fixing the admission fee at $20 was now in full force. Under the Quebec Act the fee for students is $20, and for associate members $40.

The report of the Library Committee by Wm. McNab, librarian, showed that this Committee had held five meetings during the year. The reading rooms are now well supplied with technical journals, and during the year a good many donations of books were received.

The following was the treasurer's statement:

Balance from 31st December, 1897			$6,970 65
GENERAL RECEIPTS.			
Subscriptions:—			
Arrears	$1,287 15		
Current	2,351 26		
Advance	749 66		
		$4,388 07	
Transactions sold		17 50	
Dividend on Canada Permanent Loan Co.'s stock		4 50	
Donations to Library		26 16	
Donation towards expense of Annual Meeting		2 00	
Bank interest on current account		46 99	
Bank interest on deposit account		111 81	
			$4,597 03
BUILDING FUND.			
Balance from 31st December, 1897		4,026 03	
Ketchem bequest transferred from general fund		500 00	
Interest to 31st December, 1898		130 70	
			4,656 73
			$16,224 41

GENERAL EXPENDITURE.

Transactions printed and published	$ 897 10
Advance proofs	66 54
Printing, stationery and binding	267 95
Charter, By-laws and List of Members	85 25
Postage and post cards	176 98
Messengers and telegrams	29 41
Cabs, cartage, etc	8 70
Secretary's salary, including 7 months of 1897	475 00
Assistant secretary's salary for year	488 07
Caretaker's wages for year	140 00
Caretaker for washing towels	6 00
Cost of keeping rooms open at night	62 00
Rent of rooms for year	675 00
Telephone service, including 6 months of 1897	45 00
Bank commissions on cheques	13 22
Water rates	25 22
Electric lighting for year	76 69
Books and magazines and library expenses	95 30
Expenses *re* Close Corporation	863 83
Expenses at meetings	20 75
Engrossing diplomas	22 50
Gzowski medal and engraving	11 48
Office furniture and alterations	609 38
Rent of drawer in bank vault for year	5 00
Amount transferred to building fund	500 00
Gas for grate fire	2 00
Treasurer's expenses, car fares, etc	4 34
Petty cash in hands of Asst. Secretary	1 75
	$5,674 46

BALANCES.

General Fund Treasurer	$5,893 22	
Building Fund Treasurer	4,656 73	
		$10,549 95
		$16,224 41

H. Irwin, Treasurer.
K W. Blackwell, W. McLea Walbank, Auditors.

On motion of J. M. McCarthy, seconded by Lewis Skaife, the reports were adopted,

The question of the removal of the Society's quarters and the project of purchasing a building for the Society's exclusive use led to a long discussion. The secretary explained that the owners of the present building, the Bank of Montreal, had declined to make certain small alterations to improve the lighting of the entrance, but instead proposed to allow the Society to do it, deducting the cost from the rent, but holding the Society responsible for any damage to the building. The Council did not wish to be put into a trap of this kind, and as the defect was caused by the owners blocking up the natural light at the rear they considered they were entitled to have the defect remedied without being held liable to possible damages in making the necessary changes. The discussion was resumed at a later stage, when E. P. Hannaford, who took strong ground in favor of remaining in the present rooms, moved that the present rooms be secured for a period of 3 to 5 years, and that the Council be instructed to arrange terms with the landlords.

This led to a discussion of the policy of purchasing a building or erecting one for the Society's future use. Several members expressed themselves in favor of building or purchasing, but others while in favor of the policy of having a home for the Society, thought the condition of the Society's funds did not justify the step at the present time. Messrs. Skaife, Leprohon, Vindin, and Lesage had been appointed a committee to investigate the question of new temporary rooms, and this committee now reported that two fairly suitable properties could be purchased, one in Osborne street, at $14,000, and the other in Union avenue, at $18,000. The annual cost of the former was computed at $810, and of the latter $875. The rent of present buildings is $700. After discussion Mr. Hannaford's motion was defeated, and a motion by J. M. McCarthy, seconded by C. H. Rust, was carried, leaving the whole question in the hands of the Council.

Several members desired a definition of the society's policy on the building question and this was put on record by two resolutions, the first by Wm. Kennedy, seconded by J. M. McCarthy, stating that in the opinion of the society it was not advisable to build or purchase permanent quarters at the present time, and the second, proposed by Lewis Skaife, seconded by W. B. Anderson, that it is the policy of this society to purchase a building as soon as the state of the funds shall warrant such action.

Mr. Chipman suggested that the treasurer's statement should hereafter be drawn up in the form of a balance sheet designed to show more clearly the assets and liabilities of the society for the benefit of outside members.

Mr. Jennings and others agreed with this suggestion.

The committee on the Civil Engineer's Bill for Ontario, consisting of W. T. Jennings, A. L. Hertzberg, C. H. Rust, E. H. Keating, M. J. Butler and Willis Chipman, then presented their report through the last-named gentleman, who was chairman. Mr. Chipman read the draft of the proposed act, which was based largely on the act passed by the Manitoba Legislature in 1896 and the Quebec Legislature in 1897, which established the qualifications necessary to permit persons to practice as civil engineers in those provinces. By those acts no person can practice engineering in the province unless he is a member of the Canadian Society of Civil Engineers. In Ontario it is proposed, however, to allow engineers who are now practicing to continue to do so without joining the society, provided they are qualified as engineers. The Ontario Act provides that any member who so desires, may at any time withdraw from the society and have his name struck off the register and may join again if he wishes to resume practice. Much more latitude is allowed the board of examiners under the Ontario bill than under the Quebec Act, and provision is made for consulting engineers from abroad.

On motion of Stuart Howard, seconded by Lewis Skaife, the committee on this bill was continued for the present year.

The committee on Standard Measures, which had no report to present, was also continued in office.

The committee on the Gzowski medal award recommended that the medal for the best paper for the past year be awarded to John Taylor Farmer for his paper on "Impulse Water Wheel." The announcement was received with applause.

A letter was read from the Association of Architects of the Province of Quebec, calling attention to a provision in the amended charter of Montreal, that the Board of Expropriation should consist of five men, namely, one lawyer, one architect, one civil engineer, one contractor and one real estate man, each of whom should have been at least ten years in practice.

The secretary called attention to the fact that a member had paid in to his assistant $8 without leaving his name. The member in question did not reveal himself.

The following was the result of the ballot for the election of officers for 1899:

President—W. T. Jennings, Toronto.

Vice-Presidents—P. W. St. George, Montreal; K. W. Blackwell, Montreal; and E. H. Keating, Toronto.

Treasurer—H. Irwin, Montreal.

Secretary—Prof. C. H. McLeod, Montreal.

Librarian—Wm. McNab, Montreal.

Council—G. H. Duggan, Montreal; John Kennedy, Montreal; Thos. Monro, Coteau Landing; H. N. Ruttan, Winnipeg; C. H. Rust, Toronto; G. A. Monntain, Ottawa; Duncan MacPherson, Montreal; C. E. W. Dodwell, Halifax; St. George Boswell, Quebec; W. B. McKenzie, Moncton; Ernest Marceau, Montreal; Willis Chipman, Toronto; John Galbraith, Toronto; Stuart Howard, Montreal; G. A. Wilmot, Victoria.

The Nominating Committee was as follows: For Quebec, H. Irwin and Stuart Howard; for Ontario, C. H. Rust, John Galbraith and E. H. Keating; for the Maritime Provinces, Dr. Martin Murphy; for the Northwest Provinces, H. N. Ruttan; for non-residents of Canada, W. J. Sproule.

Scrutineers—J. W. Heckman, Geo. A. McCarthy and P. de B Leprohon.

After luncheon, the retiring president's address was read by the secretary, and a vote of thanks was passed to the scrutineers.

W. T. Jennings, the president elect, was then moved to the chair. In thanking the members for the honor they had conferred on him, Mr. Jennings said that though he had been a member of the Society since its organization, he had unfortunately not been able to be present at many of the annual meetings, and had therefore never taken a prominent part in its proceedings. He had, however, always taken a keen interest in the progress of the Society and he should now feel bound more than ever to promote its prosperity and help to obtain the corporate rights which the Society desired. He urged members to contribute to the stock of knowledge of the Society, especially by papers and by monographs, relating their experience in pieces of work out of the common. He hoped the members would not be found working as cliques, but would remain united in the broad interest of the Society.

On motion of Lewis Skaife, seconded by P. de B. Leprohon, it was decided to print the Quebec Act in the next issue of the transactions.

It was moved by J. M. McCarthy, seconded by W. J. Sproule, that in view of the fact that it is the settled policy of this society to establish one civil engineers' society for the whole of Canada, which shall include all branches of the art, this council be instructed to draw the attention of the universities to the entirely different signification of the term "civil engineer" as employed by them, and as understood by this society, and request them to consider if they cannot arrange to use the term only with the full signification given to it in the charter of this society.

Mr. Jennings pointed out that last year Toronto University conferred its degree in civil engineering on a new plan, and that body not only conformed to the standard of this society, but appointed a member of the society as its own examiner in civil engineering.

It was moved by W. J. Sproule, seconded by Lewis Skaife, that it is expedient that a representative committee be appointed at this meeting to enquire into the question of the official appointment of engineers with a view to attaining uniformity in the designation of engineers, so that the terms "Chief Engineer," "Assistant Chief Engineer," "District Engineer," "Divisional Engineer," etc., may have the same definite meanings as nearly as possible, and that this committee report to the next annual meeting. Carried.

On motion of G. H. Garden, seconded by J. M. McCarthy, a vote of thanks was passed to the Grand Trunk Ry., and on motion of Mr. McNab, seconded by J. G. G. Kerry, a vote of thanks was passed to the C. P. Ry., for the courtesies extended to the society by those corporations.

On motion of Wm. Kennedy, seconded by J. G. G. Kerry, a vote of thanks was passed to the Laurentide Pulp Co. for the company's hospitality to members on their visit to Grand' Mere.

On motion of C. de B. Leprohon, seconded by W. J. Sproule, it was decided that the Nominating Committee be furnished with a note of the attendance of members of Council during the year, with explanations of the cause of absence of members from the meetings.

On the suggestion of Mr. Irwin it was decided to address a letter to Thos. C. Keefer and Walter Shanly conveying the good wishes of e society to those veteran members, and regrets that they were not able to be present.

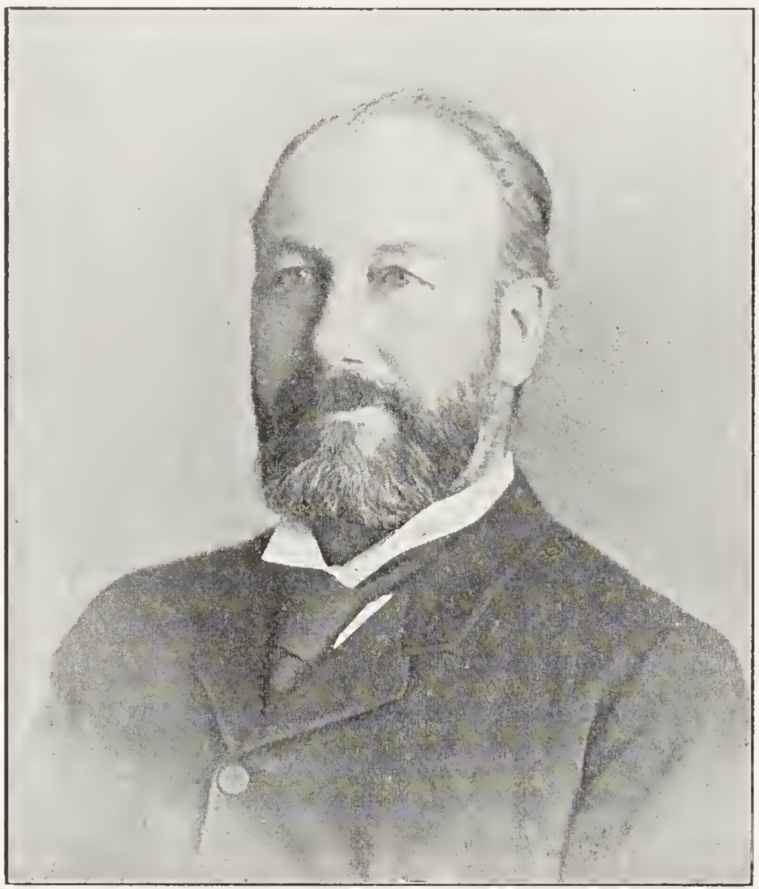
The meeting closed with votes of thanks to the officers for their services during the year.

The annual dinner of the Canadian Society of Civil Engineers was held on the evening of Thursday, 12th Jan., at the Windsor Hotel, and was voted to be one of the best, if not the very best, since the society was established.

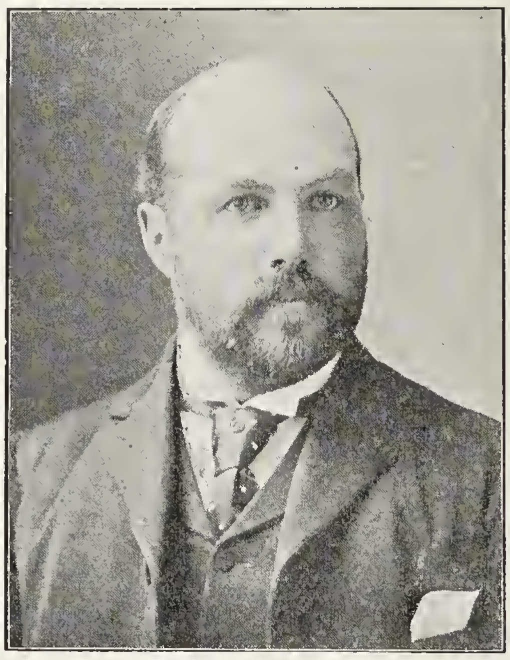
K. W. Blackwell, Vice-President, presided, and made an excellent chairman. On his right were W. T. Jennings, President-elect, Prof. S. H. Capper, E. P. Hannaford. Louis A. Vallee and Charles Baillairge, and on his left were Thos. Monro, Dean Bovey, C. W. Spencer, Edw. J. Featherstonhaugh and Major Henry A. Gray. Among the other guests present were: Henry O'Sullivan, Owen O'Sullivan, R. W. Leonard, J. A. Marion, J. A. G. Goulet, R. S. Lea, J. M. McCarthy, J. P. B. Casgrain, F. W. Cowie, A. Boyer, J. G. Macklin, Wm. McNab, W. J. Francis, Geo. E. Thomas, Henry F. Duck, C. H. Rust, M. J. Butler, R. B Rogers, L. B. Copeland, Wm. I. Bishop, L. M. Lovelace, H. Lindsor, R. P. Rogers, W. R. Butler, Jos. W. Heckman, J. G. Armstrong, R. Adams Davy, G. J. Desbarats, G. H. Garden, Robt. Surtees, Wm Kennedy Jr., F. X. Berlinguet, J. G. G. Kerry, Owen N. Evans, H R. Ives, G. A. Mountain, Duncan McPherson, Arthur H. N. Bruce, T. P. Shearwood, H. L. St. George, J. E. Dore, R. F. Ogilvy, Jas. H. Parent, John H. Walters. T. W. Lesage, E. A, Rhys-Roberts, J. S. Vindin, C. de B. Leprohon, Lewis Skaife, Frank T. St. George, N. E. Brooks, B. J. Saunders, Wm. P. Anderson, Prof. C. H. McLeod, Willis Chipman, J. Atkinson Douglas, Maurice Perrault, H. Irwin, Stuart Howard, G. H. Duggan, James Traill Shearer, and E. B. Biggar, of the CANADIAN ENGINEER, and members of the local press. The dinner was good, and the arrangements reflected credit on the Dinner Committee, which consisted of Messrs. Frank St. George (chairman) J. G. G. Kerry (sec.), C. H. McLeod, H. Irwin, Wm. McNab and C. de B. Leprohon.

After the "Queen" had been loyally drunk the chairman proposed the "Sister Societies," and in doing so spoke of the progress of learned societies in recent years, a progress greatly accelerated by unity of action and exchange of knowledge. He alluded to the presence of members of the Quebec Association of Architects, and coupled the name of Prof. Capper with the toast. Prof. Capper, in responding, said he did not know why his friend Mr. Kerry had selected him to reply to this toast. Everybody knew an architect was a man who ought to be an engineer, but is not; and as to mining, which he was also expected to include, the only thing he remembered about it was the unmitigated pleasure it gave him to get up again out of a mine after having got down into it. However, it did not matter how many subjects his reply should include—which reminded him of the story of a lady who was travelling on the Great Western Railway, of England, and who resented the intrusion of a strange gentleman in the compartment. "Sir," she demanded, as the gentleman persisted in keeping his seat, "do you know who I am?" "Madam," he replied, "I haven't the faintest idea." "I," said the lady haughtily, "am one of the directors' wives!" "Madam," he returned, coolly, "it would not have made the slightest difference if you had been the director's only wife." Prof. Capper made a number of witty hits and was well received. Stuart Howard then sang "Soldiers of the Queen," and was heartily applauded. The chairman proposed the Corporations to whose courtesies they were indebted for their entertainment, especially the two railway companies who had provided the excursions. C. W. Spencer, of the C P.R., in response said the engineers had performed their part in the evolution of railways, for if it were not for them the railways would not exist. As for the excursions, it had given the companies more pleasure in providing them than it had given their guests in participating in them. Mr. Lesage gave Sir Geo. Cartier's song "O Canada Mon Pays Mes Amours" in very good style. The toast of Visiting Members was coupled with the names of Chas. Baillairge of Quebec, and J. S. Armstrong of St. John, N.B. Mr. Baillairge said the warmth of the reception given the visiting members made up for the coldness of the atmosphere. It had been said that there was no beauty in engineering, but a man who stood on the axis of the new Victoria Bridge and viewed its magnificent proportions and immense perspective must be fascinated by the sight. We must not forget that it was a Canadian engineer, T. C. Keefer, who selected the site and laid out the work, and so well was it done that the engineers of the new bridge were enabled to rebuild it without altering the foundations at all. He made some interesting comparisons of this bridge with that of the Forth and Menai bridges; and then gave an account of the St. Charles Aqueduct at Quebec, which he had built, and around which they had erected a bridge without turning off the water. He threw two pipes across the river in the form of an arch, so that if the protecting boxes were destroyed the tubes would be self-sustaining. These two pipes were braced together so that the wind could not blow them over. To show how water may wear away iron he mentioned that a slight flaw in the pipe led to a small pin hole, which developed into a hole 2 inches in length, a result which might easily happen under a head of 486 ft. or a pressure of 208 lbs. per square inch. This society had given some light to the engineering world, for one of its members had solved the mystery of the ball-nozzle, which was a puzzle to scientists for some time, and had also anticipated the investigations carried on at the Forth bridge, and at the Tower bridge in London, when it was found that the actual pressure of the wind fell short of the indications of the anemometer by 40 per cent. The explanation was due to the same principle in both cases—the back pressure caused by the vacuum formed by the on-rush of water or air. This Society had accomplished a good deal, and should be destined for a great career. Mr. Armstrong followed, and expressed his admiration of the great engineering developments of Montreal and its vicinity. With institutions like McGill University and the two great railway headquarters, there were many incentives to engineering activity. Montreal seemed destined to be the railway and canal centre of half the continent. In the east we have the city of St. John, with its open winter port and its ambition to cope with all the increased trade that must flow to the Atlantic. The C.P.R. had done a good deal to second the efforts of St. John, and he was glad to see the G.T.R. pushing its way down to the picturesque city by the sea. We have possession there of the largest wet dock in the world, and with five miles of open water which never freezes, the city and port of St. John could look with every confidence to the future. Lewis Skaife sang Kipling's "Fuzzy-Wuzzy," winning hearty adplause. The chairman then handed over the balance of the toast list to Mr. Kerry, to whose energy and thoughtfulness so much of the success of the dinner was due. Mr. Kerry gave "Our Society," and then called on Dean Bovey, who pointed out that all our comforts in transportation were due to the engineer. With weather at zero we were now able to go from room to room, from street to street, from town to town, and from country to country, carrying our fires with us, and having our choice of coal, steam or electricity as the heating medium. He gave a sketch of the formation of the Canadian Society of Civil Engineers, much of the work of organizing which was done by the late Alan Macdougall. He hoped the time would come when one set of laws regulating the practice of civil engineers would apply to all provinces in the Dominion. Mr. Leprohon sang the "Deux Gendarmes," and received a hearty encore. Mr. McPherson gave an account of the work of the Council, on whom a great deal of detail labor fell. The Council, while willing to accept its responsibilities and shoulder the work, was also willing to listen to suggestions and get instruction from any member. Henry O'Sullivan, Inspector of Surveys for the Quebec Government, sang an amusing song, "The Old Irish Stew," to the tune of the Red, White and Blue, and supplemented his song with some interesting facts about the undeveloped resources of the Province of Quebec, especially those comparatively unknown northern regions where enormous water powers existed in close proximity to deposits of minerals and immense forests of spruce and other timber. Mr. Jennings, the in-coming president, was then called on, and congratulated the Society on the headway it had made. He would see that no stone was left unturned to advance its interests. It only remained for the members to be loyal to each other. G. E. Thomas then gave a song which was much appreciated, and Mr. St. George made a short but humorous reply to the toast of the "Ladies." Mr. Skaife proposed a bumper to Mr. Leprohon as acting chairman to dinner committee, and the company rose shortly after 12 o'clock with "Auld Lang Syne" and hands all round.

William Tyndale Jennings, President for 1899, of the Canadian Society of Civil Engineers, was born in Toronto, 19th of May, 1846, his father being the late Rev. Dr. Jennings, pastor of the First United Presbyterian Church. He was educated at the Model Grammar School, and at the Upper Canada College. His professional career began in 1869, when he commenced field work under T. N. Molesworth, engineer of Public Works, and brother of the well known compiler of Molesworth's Engineer's Pocket Book. After a year's work on the drainage improvements of the Crown lands of Ontario, under Mr. Molesworth, he entered the service of the Great Western Railway in 1870 under George Lowe Reid, chief engineer. After some experience in survey, location and construction work, he was appointed in 1873 resident engineer of the Air Line Division of the G.W.R., the London and Port Stanley and the Welland branches, under John Kennedy, chief engineer. During this time he made an exhaustive survey of the Detroit River, the company having in contemplation a bridge across the river near Detroit city. This was a joint enterprise of the G.W R. and Michigan Central, but both it and the tunnel which had been constructed about half way from the American side, and for about 500 feet on the Canadian side, in 1871, were abandoned Through the kindness of Messrs. Gzowski and McPherson, engineers and contractors of the international bridge at Buffalo, Mr. Jennings was allowed special facilities for studying all the details of that great work, and in his subsequent official positions, he was fortunate in being frequently sent on missions of investigation into new works to various parts of the continent, which enabled him to acquire a vast store of technical knowledge, of which he has been able to make good use in his professional work. In 1875 the work of construction on the G.W.R. being over, he gave up the position of resident engineer, preferring more varied work, and went into the service of the Dominion Government on the Canadian Pacific Railway under Sanford Fleming, chief engineer. He went to British Columbia as locating engineer on the B.C. Division, remaining there till 1879, and during that time, among other things, located the present line through the canyons of the Fraser River and other intricate sections. On completion of location he was moved to the Lake of the Woods as district engineer in charge of the heavy construction work from Rat Portage to Eagle River, 69 miles, and on the completion of that work returned to British Columbia, as superintending engineer for the Dominion Government under Collingwood Schreiber, Mr. Fleming having in the meantime retired. In 1882 he came east for a time on account of his wife's illness, and in the following year was offered an inspectorship of Government railways, but preferring more active work he returned to B.C. in 1883 as chief engineer for the Construction Company headed by A. Onderdonk, and acting manager during Mr. Onderdonk's absence. This work comprised 350 miles of the road from the Pacific Coast eastward, which was completed in 1885. He then took up work for the C.P.R. in Ontario, building the lines from Woodstock to London, from London to Detroit, the Wingham extension, the eastern entrance to Toronto, the Guelph Junction (as consulting engineer), and various locations of surveys, also the Toronto wharves of the C P. R. from Yonge Street westward. In 1890 he was offered the position of city engineer of Toronto, and having accepted it, reorganized the engineer's department for the city, and made many improvements of a permanent and substantial character, such as the Sherbourne street bridge, the Carlaw avenue, and King street subways (the last named from plans of his predecessor, Mr. Sproatt), the island ferry slips, etc. He also brought about a settlement in a dispute between the railway and the city as to the occupancy of the water frontage. The city having obtained the street railway franchise, released the same under specifications prepared by Mr. Jennings, which were so carefully drawn that they have formed the basis of many like franchises since obtained by large cities in the United States. About this time he was offered the chief engineership of the Public Works Department, but declined the offer, much to the surprise of many of his friends and of some members of the Government. Mr. Jennings gave up the office of city engineer, and entered into private practice in 1891, since when he has built the Niagara Falls Park & River Railway, the Galt, Preston and Hespeler Electric Railway, the Tilsonburg & Port Burwell Railway, and a number of other works of greater or less importance. From 1892 to 1895 he was chief engineer of the British Columbia Southern Railway, now better known as the Crow's Nest Railway, the route for which he examined and located in such a way as to open up to best advantage the enormous coal deposits which are now considered the key to the successful development of the mining interests of the Pacific province. In 1897 he was requested by the Government to examine into the feasibility of the route from the Pacific Coast at Fort Wrangel to Teslin Lake by way of the Stikeen River, and to examine the Teslin Lake and Hootalinqua River to determine its navigability, and further to examine the passes at the head of Lynne Canal, such as the White, the Chilcat and Chilcoot passes. This work was successfully carried out, and his report on this subject has already been referred to in these columns. Last year the Toronto and Hudson Bay Commission created by the City Council of Toronto, selected Mr. Jennings to examine the country from North Bay to James Bay, embracing the Temiscamingue, Temagami, Blanche River, Montreal River and Wahnapitae, which he did during the past summer, obtaining a great amount of information on a comparatively little known region of country, and which information is being laid before the commission for future action with regard to a projected railway to Hudson Bay. Mr. Jennings is a member of the Institution of Civil Engineers of Great Britain, a member of the American Society of Civil Engineers, of the British Association for the Advancement of Science, and of the Imperial Institute. In 1897 he was appointed by Toronto University as examiner in the Department of Civil Engineering under the new system introduced in that year for the conferring of the degree of civil engineer, an honor which may be considered of all the greater value by reason of having been made without his previous knowledge, and by reason of his selection as sole examiner. In 1876 Mr. Jennings married Miss McKay, daughter of the Registrar of the county of Elgin. Mrs. Jennings died in 1887, leaving one son, Gordon T. Jennings, now at the Royal Military College, Kingston, with every prospect of a worthy military career. Mr. Jennings has always had a high conception of the profession of a civil engineer, and his election to the highest honor in the gift of the society is a happy reward for a career marked by faithful adhesion to public and private duty.



Yours truly
Wm T. Jennings.



GEORGE A. MOUNTAIN.

George A. Mountain was born in Quebec in 1860, and served his apprenticeship in the office of the city engineer of Quebec. In 1878 he served on the engineering staff of Kinniple & Morris, civil engineers, London and Greenock, on the surveys of the Quebec graving dock and the Louise embankments; in 1879 he was assistant engineer on the surveys of the Quebec and Lake St. John Railway; in 1880, assistant engineer on the surveys of the Island Railway, Newfoundland; 1881 to 1886, divisional engineer on the Canada Atlantic Railway, and from 1886 to the present time chief engineer of the Canada Atlantic Railway; 1889, chief engineer of the Coteau bridge across the St. Lawrence River from its inception to its completion; 1891, chief engineer of the St. Lawrence and Adirondack Railway; 1890, to the present time, has been chief engineer of the Ottawa, Arnprior and Parry Sound Railway; and from its commencement also chief engineer of the Parry Sound Colonization Railway from 1892 to 1896. Mr. Mountain became a member of the Canadian Society of Civil Engineers at its organization in 1887. He is a D.L.S., O.L.S., P.L.S. At the present time Mr. Mountain is chief engineer in charge of construction and maintenance-of-way on what is known as the Booth system of railways, comprising Canada Atlantic Railway; Ottawa, Arnprior and Parry Sound Railway; Vermont and Province Line Railway; Nipissing and Nosbonsing Railway.

C. E. W. DODWELL, MEM. CAN. SOC. C.E.

C. E. W. Dodwell, B.A., is a son of the late Rev. G. B. Dodwell, M.A. He was born in England in 1853, and in 1862 he came to Canada, beginning his education at Bishop's College school, Lennoxville, and finished at King's College, Windsor, N.S., where he took a full course of engineering and the degree of bachelor of arts, with high honors in mathematics and natural sciences. From 1873 to 1877 he was employed as assistant engineer on the location and construction of the principal lines of railways in Nova Scotia, namely, the Western Counties, the Nova Scotia Central and the Eastern Extension Railways. In 1877 he was appointed assistant provincial engineer under the Government of Nova Scotia. This position he resigned in 1881 to accept an appointment upon the staff of the Canadian Pacific Railway in Montreal. Mr. Dodwell was in the service of this company for about eight years, and during that time was engaged almost exclusively upon construction. The preliminary surveys and estimates for the St. Lawrence bridge were his first work, performed for the company with G. H. Massey, C.E. He was next employed upon the construction of the Ontario and Quebec Railway, first in the position of section engineer, subsequently in charge of the construction office in Toronto. He was next resident engineer in charge of the portion of the C.P.R. from Montreal to Vaudreuil (24 miles), which comprised some heavy work, namely, the large stone viaduct entering the city and the bridges, 33 spans of steel, over the Ottawa River at St. Anne's and Vaudreuil, on which latter work he submitted a very clever paper to the Canadian Society of Civil Engineers in 1888. (See Vol. II., part I.) In 1889 he resigned his position on the C.P.R., and in partnership with A. L. Hogg, M.I.C.E., Mem. Can. Soc. C.E., established the firm of Dodwell & Hogg, for a general engineering practice. Occupying his time at this period may be mentioned the waterworks and sewerage systems of Dartmouth, and the waterworks of Amherst, N.S. In 1891 he accepted an appointment under the Federal Government as resident engineer of the Public Works Department, at Halifax, N.S., which position he still occupies. Mr. Dodwell was elected an associate member of the Institution of Civil Engineers in 1881, and he was transferred to the class of members in 1891. He took an active part in the formation of the Canadian Society of Civil Engineers, being one of the original Montreal committee.

FIRES OF THE MONTH.

Jan. 10th. Joyner & Elkington's grist mill, Fort Qu'Appelle, N.W.T., burned; loss is $25,000.——Jan. 11th. Bell & Co.'s tannery, Tilsonburg, Ont.——Jan. 12th. Tara, Ont., public school; loss, $3,000.——Jan. 15th. The charcoal works at Bridgeville, N.S., burned down; loss, $10,000.——Jan. 15th. St. Anne's College, Digby, N.S., loss, $75,000.——Jan. 20th, Roman Catholic church at Rockland, Ont., destroyed.——Jan. 22nd. I.C.R. coal sheds at Moncton, N.B., loss, $1,500.——Jan. 24th. Hercules' Cement Works, Hamilton, Ont.; buildings gutted and stock destroyed.——Jan. 26th. Small fire in Montreal Gas Co.'s works, Montreal, caused damage of $500.

CORRECTIONS.

On page 242 of the January issue of The Canadian Engineer, in the last paragraph of J. M. Williams' article, "Oiling Up," the word "animal" was used instead of "mineral." The sentence should read: " . . we may be satisfied that in the mineral oils and greases, with their great range of body, their freedom from impairment by atmospheric action and other physical changes, that we may obtain a lubricant fitted especially for our requirements. . . ."

The editorial paragraph in the December issue of The Canadian Engineer did not imply that the Quebec gold areas were the property of the De Lery family, but stated that those of the seignory of Rigaud-Vaudreuil were so held.

REVIEWS.

The Canadian Magazine for February contains some interesting Canadian matter; the portraits of forty editors of Canadian dailies and biographical sketches of each; St. George's Cathedral, Kingston, which was destroyed by fire recently, is the frontispiece; Joanna E. Woods' novel is continued, and the usual complement of short stories and poems finds its place. Unfortunately the series of papers on actors and actresses is kept up. The public will not pay twenty-five cents for a magazine which publishes theatrical portraits. It is distinctly a "marked down" commodity and should be dropped.

Diane of Ville Marie is the title of a new romance of French Canada by Blanche Lucile Macdonell, of Montreal. Miss Macdonell is the author of a number of charming sketches of French-Canadian history and folk-lore, and the present tale, her most ambitious venture, founded on events which took place on the Island of Montreal at the close of the 17th century, shows her to be well versed in early Canadian history. It is well for English-Canadians to know how rich French Canada was in the material of heroes and heroines, for the story is woven around the personalities and lives of actual historical personages, as stated in the preface. The work is handsomely produced from the press of Wm. Briggs, Toronto.

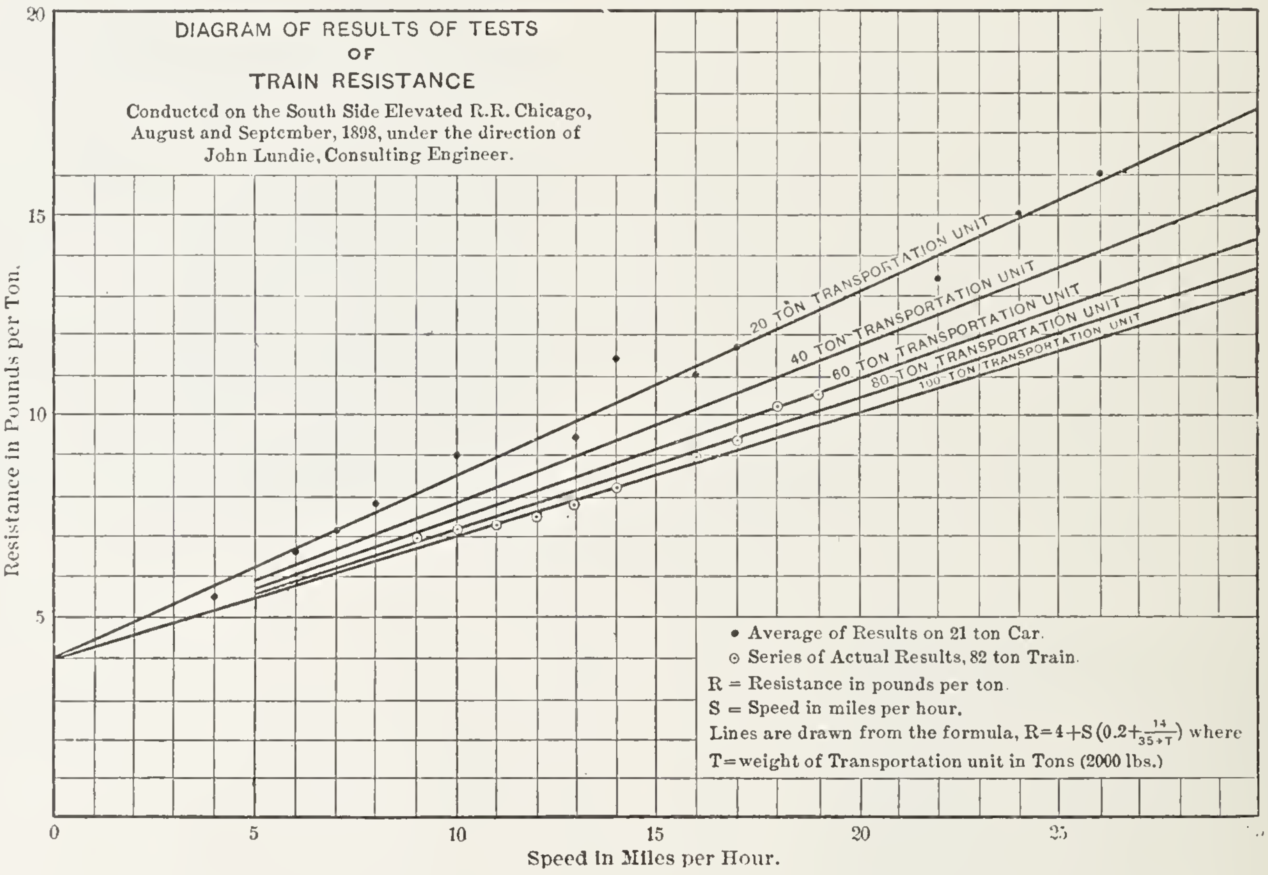
La Quincena Rural.—We have received the first two numbers of this journal published in Buenos Ayres, which is devoted to agriculture and the kindred arts. As its name implies, it will be published twice a month. The subscription price is $20 per year for the capital, and $22 in the country, rates which it is feared will not ensure a large circulation. The rates for advertising are in proportion. One article complains of the want of affection for rural life in the young people of the country preferring to agriculture almost any other occupation, and even "passa los dias en intrigues politias." Sons of the Spanish-American farmers everywhere possessing a territorial patrimony cannot be induced to continue to reside on it, much less to study its proper management. From this practice the agriculture of the country suffers severely. The deserters of the country districts do not appear to despise their properties, but either leave the management of them to a dependent or try to direct the management from the town in which they have taken up their residence. And as the proprietor does not know how to manage the property advantageously each of these plans is equally fated. The small farmers who remain on the land manage much better. The work is done by the family, male and female, and the surplus produce sold. Here in Canada we know as a rule very little about South America. It is obvious from this glance that there is much in the agriculture of that country that is similar to what is found in ours. The editorials in this paper are brightly written and are of a very high class, comparing favorably with the best we have in America.

A NEW GENERAL FORMULA FOR TRAIN RESISTANCE.*

The alchemists of old sought diligently for the philosopher's stone, the inventors of a later age for perpetual motion, and engineers of the nineteenth century have been almost as eager to obtain a general formula which shall reconcile all existing data and experiments upon train resistance. The first two objects of effort are now known to be unattainable, and the third has until now baffled the best minds in the railroad profession. Only a month ago Locomotive Engineering, which for years past has devoted special attention to this subject, said editorially: "We do not believe that it is possible to devise a formula that will show an approximation of the resistance due to different kinds of trains at different speeds when train tons are the basis of calculation."

A general formula which appears to be applicable to passenger trains of all weights, running at all speeds up to the highest limits so far reached, has been lately worked out, however, by John Lundie as a result of a long series of tests of trains in actual service, and is here given to the engineering public for the first time. His methods of obtaining data are decidedly different from, and much more satisfactory than those commonly employed hitherto, where indicator cards of engines drawing trains at constant (?) speed on level (?) track have been made the basis (with an arbitrary allowance for engine friction) of estimates of resistance per ton moved. In order to be of any value such tests must be made in long distance runs, and it is almost impossible to find a hundred miles or more of absolutely level track for the purpose, while it is also difficult to obtain perfectly uniform speed even on a dead level. Mr. Lundie's method of determining train resistance is based on an examination of the speed curves of a train when coasting from any speed to a dead stop. The possibilities of such a method will be instantly evident to an engineer, and it may be said, at once, that the results warrant a decided predisposition in its favor. It is not only possible to obtain the gross resistance due to track and journal friction and air resistance combined, but to differentiate between the air and the friction elements. The frictional resistance of a train being reasonably constant within somewhat wide limits of speed, the speed curve should be a nearly straight descending line from full speed to a point somewhere near a full stop. Now the actual speed curve dips below this straight line, as seen in Fig. 2, clearly showing a decreasing retarding force (due to air resistance), with decreasing speed.

In Fig. 1 are shown in graphic form the results calculated from more than 150 runs made by Mr. Lundie with trains of different weights on the South Side Elevated Railroad of Chicago. It will be seen that these results expressed by the location of points on the diagram, cluster around "straight line curves," and that these lines intercept each other, with surprising accuracy, at a single point located at a definite distance above the origin. This indicates, of course, that the first step in obtaining the final formula has been reached, in the establishment of a constant, representing the minimum possible train resistance for all speeds and weights, and it is interesting to note, by the way, that in none of the recorded experiments so far made on passenger or freight trains of all weights has the resistance per ton been less than the figure indicated by this constant—4 pounds.



Mr. Lundie's formula is as follows:

$$R = 4 + S\left(0.2 + \frac{14}{35 + T}\right)$$

where

T=the weight of the transportation unit in tons (2,000 lbs.)

R=resistance in pounds per ton.

S=speed in miles per hour.

It will be seen at once that unlike most previous formulae, there are here two variables after the constant, namely speed and train weight. Many other investigators have endeavored to accomplish this, but unsuccessfully, and in the formula which has been in most general use in engineering hand-books, that of D. K. Clark, speed only appears as a variable. From a careful study of his results, Mr. Lundie developed the formula on the following mathematical basis: The expression by which "S" is multipled is proportional to the tangents of the angles made by the lines developed for different weights, as shown in Fig. 1, and is the characteristic of a rectangular hyperbola which (throughout the range of tests made) co-ordinates quite accurately the relations between train weights and the inclinations of the lines mentioned for corresponding weights. The term 0.2 is an intercept on the axis of y; 14 is the constant product of x and y, with the intersection of the asymptotes as origin; and 35 is an intercept on the axis of x.

The test of any formula lies in its application. Gauged by this test, Mr. Lundie's formula unifies in a remarkably close manner nearly all recently published experiments, together with other formulae of more limited application, as will be seen by an inspection of the accompanying table. The Stroudley, Sinclair and Dudley tests of train resistance scheduled in this table were brought together by A. M. Wellington in The Engineering News in 1892, and referred to as intrinsically worthy of confidence on account of the careful manner in which they were made. To these we have added further experiments made on the Philadelphia & Reading Railroad in 1889, and on the Central Railroad of New Jersey in 1892, so that a fairly complete range of train weights from 200 to 400 tons, and of train speeds from 40 to 70 miles per hour is given in the table. The Lundie formula checks up all these tests very closely, though in all but one case the results obtained by its use are slightly higher than the observed results. In this connection it may be noted that Mr. Lundie obtained his speed figures by positive methods, having found that speed recorders for variable speeds are not sufficiently accurate owing to the inertia of the moving parts.

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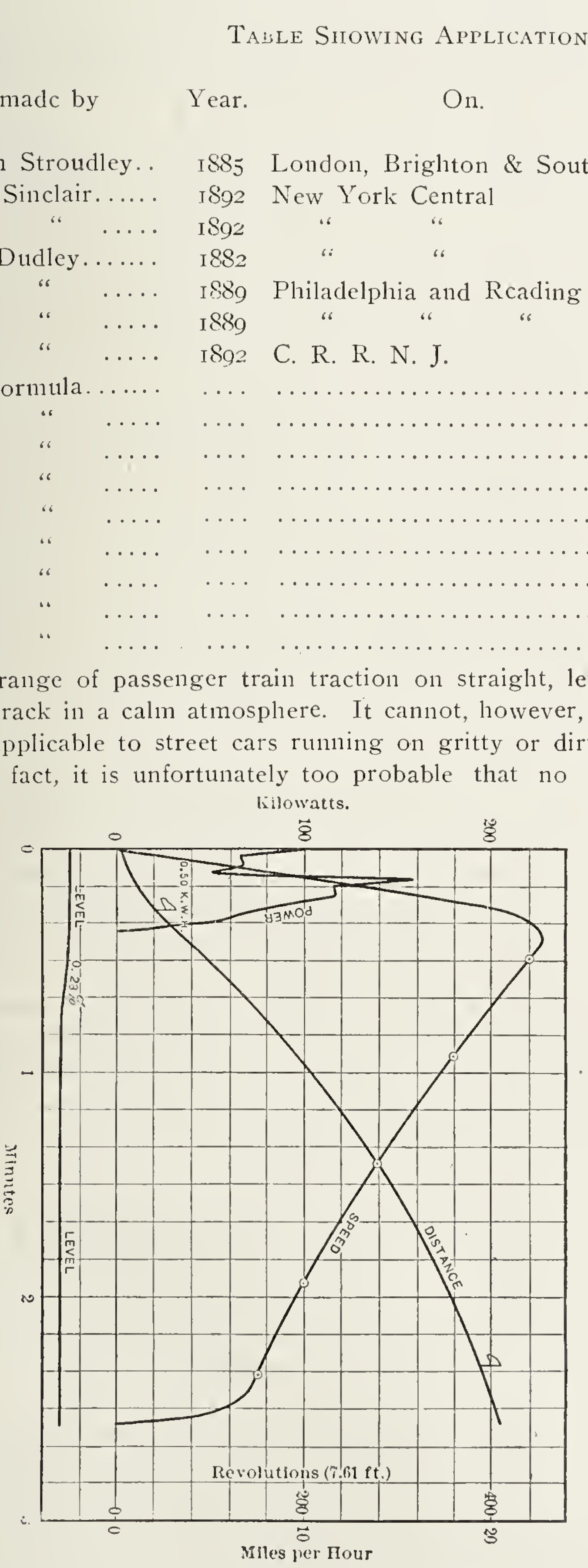
*From the Street Railway Journal, Feb., 1899.

These tests are all for heavy railroad passenger trains, upon which Mr. Lundie himself has made no experiments. For trains of from 20 to 100 tons, and for speeds of from five to thirty miles per hour, the Lundie formula is accurate, inasmuch as it is obtained directly from 150 or more observations made by Mr. Lundie in Chicago, as before stated. For lighter units still, the formula agrees with the results of private tests made by several of the great electric companies, and checks very well indeed the Clark formula

$$(R = \frac{S^2}{171} + 7.16).$$

bearing in mind that the latter is generally admitted by engineers to be from one to two pounds too high.

Now it need scarcely be pointed out that when a formula of this general kind, deduced on mathematical principles from a large series of experiments within a comparatively narrow range of action, is found to be equally applicable over a much wider range, a strong presumption in favor of the soundness of its underlying principle is established. It seems practically certain, therefore, that the Lundie formula is thus applicable to the whole range of passenger train traction on straight, level, exposed track in a calm atmosphere. It cannot, however, be said to be applicable to street cars running on gritty or dirty rails, and, in fact, it is unfortunately too probable that no formula whatever can be devised for street railway work for which a large factor of safety would not have to be allowed in practice to provide for great differences in condition of track.



An interesting question now arises as to whether the Lundie formula can be made, with some modifications, applicable to all kinds of train transportation, freight as well as passenger. It does not check the most recently obtained data for exceedingly heavy trains. Tests on the Chicago, Burlington & Quincy Railway, made by the old method of engine indicator diagrams, checked by dynamometer car, show that a 940-ton train of loaded freight cars, running at 20 miles an hour, has a resistance on a straight, level track of 5.5 lbs. per ton. By the Lundie formula this would have been 8.3 lbs. per ton. An extremely heavy train of freight cars on the New York Central, weighing 3,428 tons, had an average train resistance, at 20 miles per hour, of about 4 lbs. per ton, or the limiting resistance by the Lundie formula as expressed in the first constant. Other tests on fairly heavy freight train work recently made have shown approximately 6 pounds per ton as an average, when track conditions were good, but these results vary greatly with the condition of the track.

Now it being reasonable to suppose that with the heaviest freight train work the train resistance will approach the minimum, and the New York Central experiment above referred to indicating that this minimum is Mr. Lundie's first constant of 4, it would seem that the latter's first constant within the parenthesis, namely .2, must be inapplicable to very heavy freight-train work, and should be, in fact, modified by a variable, probably T. It would be interesting, therefore, to bring together and plot in diagrammatic form, reliable results of a large number of freight-train tests taken with different weights and speeds, to see if a modification of the Lundie formula cannot be made for general application to the heavy class of work as well as light, and we are inclined to believe that were this experimenting once done there might quite possibly be found a common ground of reconciliation between the two grades of service, by which a formula possessing the general characteristics developed by Mr. Lundie could be made applicable to the entire range of railroad transportation. We believe this formula to be so valuable a part of the technical equipment of a railroad engineer, that we earnestly hope it will excite the widest possible comment and criticism in the engineering press to the end of bringing out all the evidence bearing upon its reliability.

Table Showing Application of Lundie Formula to Train Resistance Tests.

Test made by	Year.	On.	Mem.	Average Speed. Miles p. h.	Train Weight. Tons.	—Train Resistance— Observed.	Lundie Formula.
William Stroudley..	1885	London, Brighton & South Coast.	Single test	43.3	376	13.2	14.1
Angus Sinclair.....	1892	New York Central	Mean of six tests	70.	270	19.03	21.1
“ “	1892	“ “	Single test	69.6	270	19.8	21.2
P. H. Dudley.......	1882	“ “	Single test	51.43	313	16.9	16.35
“ “	1889	Philadelphia and Reading	Single test	60.	242.5	18.35	19.0
“ “	1889	“ “ “	Single test	63.5	242.5	19.8	19.9
“ “	1892	C. R. R. N. J.	Single test	63.2	213	19.0	20.2
Clark formula......	....	....	....	10	100	7.74	7.04
“ “	....	....	....	10	200	7.74	6.6
“ “	....	....	....	10	300	7.74	6.4
“ “	....	....	....	20	100	9.5	10.06
“ “	....	....	....	20	200	9.5	9.2
“ “	....	....	....	20	300	9.5	8.8
“ “	....	....	....	30	100	12.42	13.1
“ “	....	....	....	30	200	12.42	11.8
“ “	....	....	....	30	300	12.42	11.3

ACCIDENTS.

E. Donald, an employee of the Record Foundry and Machine Co., Moncton, N.B., was caught while oiling some shafting about 15 feet above the floor a short time ago. His clothing was completely stripped off and he escaped without other injury than a few bruises, and a severe nervous shock.

Chas. H. Martin, some years ago of Martin & Son, iron founders, Belleville, Ont., was killed by the bursting of an emery wheel in Chicago, a short time ago.

Cornelius McGourty, contractor, St. John, N.B., was killed, January 6th, by a dynamite explosion near the Mispec pulp mills. A bag containing dynamite caught fire and Mr. McGourty tried to carry it to the stream close by, but the explosion came before he reached it, and he was blown to pieces, the workmen, whom he had called on to save themselves when the fire was first noticed, all making their escape.

William Tossel, employed at the Imperial Oil Co.'s works, Petrolia, Ont., had occasion to go on top of the stills recently, and by some means he fell to the ground and was killed.

Arthur Dunnett, employed by the Brantford, Ont., Starch Co., came in contact with a belt and received serious injuries before he could be rescued.

J. McTavish, North Bay, Ont., a C.P.R. brakeman, was run over by his train at Eau Claire, Jan. 21st, and received injuries from which he very shortly afterwards died.

By the explosion of the boiler in the ice house of the Knickerbocker Ice Co., Toronto, A. Evoy was killed. The jury found that the neglect of the engineer had been the cause of his own death.

Industrial Notes.

Hamilton, Ont., will begin its new $30,000 sewer on Birge avenue this year.

The capital stock of the Gurney Foundry Co., Ltd., has been increased from $350,000 to $750,000.

The Canadian Rubber Co., Montreal, has ordered a 30 h.p. engine from the Robb Engineering Co., Amherst, N.S.

During 1898 the Galt, Ont., waterworks pumped 236,999,944 gallons and the gross revenue was $12,381.94

The Diamond Glass Co., Ltd., is applying to Parliament for leave to enlarge its capital from $500,000 to $1,000,000.

The Perth, Ont., Public School will be enlarged at a cost of $5,050. Geo. Bradford, Almonte, Ont., has the contract.

It is announced that the Manufacturers' Life Insurance Company will erect a $35,000 building at Brantford, Ont.

The laborers in the Frost & Wood works, Smith's Falls, had a 10 per cent advance in wages given them January 1st.

A by-law guaranteeing the interest on $15,000 bonds of the Chatham Cold Storage Company was defeated at Chatham recently.

H. J. Powell's plans have been accepted for the Melville Presbyterian church at Fergus, Ont., to be built at a cost of about $15,000.

Messrs. Knight Bros., Burks Falls, Ont., have ordered a 60 h.p. automatic engine from the Robb Engineering Co., Amherst, N.S.

The Bras d'Or Gazette states that surveys are to be made at Glace Bay as well as Louisburg for a site for the proposed smelting works.

There are three suits for damages pending against the City of London in connection with the City Hall catastrophe that took place a year ago.

The Hamilton and Toronto Sewer Pipe Company will build a three-story structure, costing $11,400, to replace the burned buildings in Hamilton, Ont.

A Vancouver firm has been awarded the contract for supplying that city with four miles of 22-inch double riveted steel water pipe and fittings at a cost of $40,000.

The Thousand Island Carriage Company, Gananoque, Ont., has gone into liquidation, with J. T. Green as liquidator. The works have not been running since Christmas.

Campbelltown, N.B., has an arbitrators' bill of $8,000 and almost as much more for legal expenses to pay before it can take up the award in the recent waterworks arbitration.

C. A. Matheson, Perth, Ont, who owns some swamp land near the town, has bought a 15-ton peat plant, and the patent right to manufacture peat fuel in the county of Lanark.

Letters patent have been issued incorporating R. Gray, J. S. Gray, M. Daniels, J. A. McKeon, M. Campbell, Chatham, Ont., as the William Gray & Sons Co., Ltd. to manufacture carriages and other vehicles and also bicycles in Chatham, Ont., with a capital of $150,000.

Kincardine, Ont., will make a loan of $4,000 to Hunter Bros., manufacturers of boilers, etc.

An explosion wrecked one of the buildings of the Stratford, Ont., gas works recently. Damages were about $2,000.

Jas. Fleming, St. John, N.B., has supplied the boilers for W. H. Fowler's new flour mill, Rodney wharf, St. John.

A citizens' committee has been appointed in Guelph, Ont., to forward the installation of a system of sewage disposal.

Robert Bell, iron founder and machinist, Seaforth, Ont., will receive a loan of $17,000 from the town to extend his business.

Woodstock, Ont., Board of Trade proposes to raise by taxation $25,000 "to be given to new industries which may locate in Woodstock."

The Macdonald Mnfg. Co., Toronto, whose premises were burned some time ago, is about to build a $32,000 factory to accommodate 125 hands.

The employees of the Ontario Rolling Mills, Hamilton, held a ball January 21st at Grimsby, Ont., going down on a special on the H.G. & B. electric railway.

Seaforth, Ont., asks leave of the Ontario Legislature to make a loan without interest to T. R. F. Case & Co. of $20,000, to enable them to establish a pork-packing industry in the town.

In one week, not long ago, a Waterloo furniture manufacturer shipped a car-load of office desks to Liverpool and took an order for the furnishing of a church in Cape Town, South Africa.

The Montreal Water Commissioners have decided to secure an engine temporarily for the high level pumping station until the new boilers which are considered necessary can be supplied.

The Quebec Bridge Company have held a meeting, under the presidency of Mayor Parent, and decided to award the contract on March 1st, and go on with the work as far as their finances will allow.

The property owners of Oshawa, Ont., voted on Jan. 21st on a by-law to raise $110,000 by issuing debentures for a waterworks and sewerage system, resulting in the by-law being carried by a majority of 67.

An explosion of acetylene gas recently in the general store of the A. B. Scott Co., Millbrook, Ont., caused, it is said, by recharging the generator while in use, partially wrecked the building but only slightly injured the employees.

Robert Arnott has rebuilt his cheese-box factory at Peterboro, Ont., which was damaged by fire last June. The new factory is equipped with all the newest and most modern machinery. It has a capacity of 100,000 boxes per season.

An experiment of interest to people in the Ottawa Valley is to be tried at Trenton, Ont. A number of mechanics in that town have formed a co-operative lumber cutting and furniture manufacturing company, with a capital stock of $30,000. They expect to employ 75 men and the business will be managed by seven mechanics.

Application will be made at the next session of Parliament to amend the charter of the Alberta Irrigation Company by changing the name of the company to the Canadian Northwest Irrigation Company; changing the place of head office to London, England; authorizing directors to vote by proxy; increasing capital to $1,000,000.

The $20,000 necessary to establish the building and plant for the proposed pork packing industry at Middleton, N.S., has been subscribed, but as almost as much would be necessary to carry on the business the project will not be gone on with for some months, though the capital will undoubtedly be soon subscribed. E. D. Davison, Bridgewater, N.S., is president of the company.

The Commissioner of Crown Lands for Ontario has offered a prize of $10, to be competed for by the students of the School of Practical Science, Toronto, in some subject relating to forestry, to be named by the principal. The announcement was made by Thomas Southworth, chief of the Forestry Department of Ontario, to the Engineering Society of the School of Practical Science, which he addressed on the subject of Engineering as Related to Forestry in Ontario.

It is learned that the Dominion estimates for the ensuing year will contain votes for the erection of a new building for the Geological Survey and Museum, and also one for the records and archives.

The following officers of the Toronto Board of Trade have been elected by acclamation: President—A. E. Kemp; first vice-president—A. E. Ames; second vice-president—W. E. H. Massey; treasurer—J. L. Spink.

T. T. W. Bready, J. Love and C. R. Tryon, Winnipeg, Man., and J. Carruthers and C. W. Band, Toronto, are applying for a Dominion charter as the Winnipeg Elevator Company, Ltd., with a capital of $300,000.

W. P. McMicking, D. J. Bastien, W. H. Spillman, E. E. Adams, J. McC. Field, W. Smith, J. S. Greenhill, Leamington, Ont., and W. E. Lee, Virgil, Ont., have been incorporated as the Leamington Veneer and Basket Co., Ltd.; capital, $3,000.

A. W. Campbell, Provincial Road Instructor, recently went to Cornwall, Ont., to consult with the Town Council there regarding the disposition of $20,000, which has been voted by the ratepayers for the purchase of machinery and the construction of a number of new roads.

C. Cannom, G. N. Weeks, L. Nichols, J. H. Dunn, R. A. Little, and G. F. Morris, London, and J. E. McGuffin, Township of London, have been incorporated as the Cannom Stove and Oven Company, Ltd., with a capital of $20,000, to do business as manufacturers of stoves etc., in London, Ont.

W. Sproule and S. W. Trusler, Plympton, Lambton county, Ont.; G. Knight, T. Carrick, Sarnia, and R. E. Moss, M.D., Port Huron, Mich., have been incorporated as the Lambton Oil Co., Ltd., to deal in and refine oil, etc.; capital, $20,000; chief place of business Sarnia, Ont.

The advertisement of the wire rope output of the B. Greening Wire Co., Hamilton, reminds us of the fact that that old and firmly established firm is now being managed by the third generation of its founder's family, as is pleasantly told by the portraits of the three members of the Greening family on the calendar issued by the firm.

It is reported that the total sales of lumber in Manitoba and the Northwest this year exceed those of last year by about 30,000,000 feet. The quantity of spruce cut in Manitoba mills is estimated at 15,000,000 feet in excess of last year. The growth of the trade in imported lumber from the United States has been very great. In 1892, before the duty was taken off, the importation of rough lumber was only a little over a million feet, while that of dressed lumber was very much smaller. In 1897 the importation from the States amounted to 16,000,000, and in 1898, 35,000,000 feet. This is of course, chiefly undressed lumber. The quantity of pine from the Rat Portage mills is estimated at over 50,000,000 feet.

W. M. Watson, Toronto, has designed and completed a model of a square built hot air furnace. The height is 5½ feet by 3 feet by 3 feet square. The fire pot is circular, measuring 22 inches across, and is 12 inches deep. The cold air enters at the floor line, and is conducted by bent channels upward in thin streams over the radiating plates in a way that causes a very rapid current and great heating power. The advantage of this method of heating air is, the inventor claims, that about 75 per cent. more cold air can be heated to a given temperature with the same weight of coal as is used by the present hot air furnaces, because it contains over 150 square feet of direct heating surface plates that are self cleansing and cannot become coated by soot or dust. This furnace can, it is stated, be manufactured quite as cheaply and would be as durable as any other furnace.

The Fairbanks Co., which for many years has had an agency in Montreal for its well-known scales, has opened a warehouse of its own. The Fairbanks Co. controls besides its scales, the output of a number of factories, and at the show rooms their products are on exhibition. The asbestos disc valve of this company, for which an advertisement is inserted on another page, is an article of the highest grade. Asbestos seat gate valves, asbestos packed cocks, and Vulcabeston packings complete this line. Trucks of all kinds are in evidence. Norton emery wheels and Nicholson files are also carried. In the basement is a 6 h.p. gas engine of the Fairbanks' Company's own make, used to work the lift and furnish power for the repair shop. The Fairbanks Co. has just issued a 240 page catalogue of supplies, which they will gladly send on request.

Electric Flashes.

Hanson Bros. syndicate of Montreal has taken possession of the Havana street railway.

At Ottawa the Sunday car vote resulted in an overwhelming majority for the cars. The figures are: For, 4,628; against, 1,664; majority for, 2,964.

A vote was taken January 9th in Bradford, Ont., on a by-law to raise $6,000 for the purpose of putting in an electric light plant. The by-law was defeated.

The Department of Railways and Canals has placed an order with the Canadian General Electric Co. for additional apparatus to be used at the Sault Ste. Marie Canal.

The Bell Telephone Company has decided to place more of its wires under ground in Hamilton, Ont., as there has been very great loss occasioned by sleet storms on more than one occasion.

The Hawthorn Woolen Mill Co., of Carleton Place, Ont., is increasing its lighting plant and has placed an order with the Royal Electric Co. for a 25-k.w. bipolar generator, which is to be installed at once.

The Canadian General Electric Co. is installing for H. A. Lozier & Co., Toronto Junction, Ont., one of their 200-light dynamos, with marble panel, and wiring up some 200 incandescent lights, in their new factory.

The Watson Mnfg. Co., St. Catharines, Ont., is removing to its new factory at Paris, Ont., and has placed an order with the Canadian General Electric Co. for the wiring up of the factory, and installing a plant to furnish some 250-16 c.p. lamps.

Incorporation is sought for a company under the name of the British Columbia Telephones, Ltd., to acquire the New Westminster, B.C., and Burrard Inlet Telephone Company, Ltd., and the Vernon and Nelson, B.C., Telephone Company.

The Central Construction Co., 263 Main street, Buffalo, N.Y., whose specialty is water, steam and electric power plant construction, has the contract for the Orillia, Ont., electric power plant at $75,000, for which the ratepayers voted the necessary funds on February 6th.

At the electric railway car shops, Niagara Falls, Ont., eight men are employed in the building of six large new open cars for the use of the road during the summer, and one of the cars is now completed. It is a double truck, 35 feet long, with a seating capacity of 75 people.

Incorporation is asked for the Hamilton and Caledonia Ry. Co. to construct a railway from Hamilton, Ont., to Caledonia and Cayuga, and extend it to Selkirk, a point on the shore of Lake Erie. The line may be operated by steam or electricity, and will also deal in natural gas.

N. P. Tanquay, Esq., of Weedon, Quebec, has contracted with the Canadian General Electric Co. for a standard 55-k.w. new type multi-polar generator, and a 35-h.p. motor, together with marble panels and all line material and supplies required for carrying out the transmission of the above power.

The works of the Chambly Mnfg. Co., have been somewhat damaged owing to ice breaking the apron of the dam. A new timber apron has been constructed, five feet thick, and no further trouble is believed to be possible. The installation is expected to be entirely complete, and the current turned on about May 1st.

The Bruce Mines and Algoma Railway Company asks for an Ontario charter to construct a railway from Bruce Mines, Ont., northerly to the Rock Lake Copper Mines, thence northerly a distance of thirty miles, with power to equip by steam or electricity, and if the latter, with power to sell the surplus electric energy for light, heat and power purposes, and to supply the miners with electricity for their mines, and also to construct branch lines of railways not exceeding twelve miles in length.

The Canadian General Electric Co. has just received another order from the Montreal Ry. Co., for 12 standard G.E. 1,000 railway motors.

The Stanstead Electric Light Co., Stanstead, Que., has recently purchased a 2,000-light single-phase alternator from the Canadian General Electric Co.

The Canadian General Electric Company has closed a contract with A. S. & W. H. Masterman, Montreal, for a new type multi-polar 200 light generator.

A. Gagnon & Co., Arthabaskaville, Que., have recently installed a new 2,000-light single-phase alternator of the Canadian General Electric Co.'s new type.

The Ottawa Electric Co., Ottawa, has recently added to its arc lighting equipment, one No. 12 125-light Brush arc dynamo, purchased from the Canadian General Electric Co.

The Hamilton, Ont., Street Railway Co. paid the city for mileage and percentages on gross receipts for the last quarter of 1898, $3,602.21. For the same quarter in 1897 the amount was $4,163.49.

The Guelph Light & Power Co. has recently purchased a new 1,000 light single-phase alternator from the Canadian General Electric Co., together with marble switchboard panels for the control of two machines.

The R. & O. Navigation Co. has placed an order with the Canadian General Electric Co. for a standard 30-k.w. direct-current generator, to be direct connected to an "Ideal" engine, manufactured by the Goldie & McCulloch Co., of Galt.

The town of Essex, Ont., is to have an incandescent system of electric lighting. C. E. Naylor, of that place, having undertaken the operation of the system, has purchased from the Canadian General Electric Co., a 750-light machine for the purpose.

The Canadian General Electric Co. has recently installed for Robertson, Rowland & Co., Walkerton, Ont., a 2,000-light single-phase alternator. This company has been operating a 60-k.w. machine, of a similar type, for the past four years, and has met with great success in the electrical lighting.

The corporation of the town of Bothwell, Ont., has awarded a contract to the Canadian General Electric Co., for a 500-light plant, to be used for commercial and street lighting purposes. The lighting of the streets will be done by 15 enclosed arc lamps, of the latest type, which will be operated from the same machine.

The E. T. Wright Company, Hamilton, Ont., is having installed in its factory a 50-h.p. S.K.C. motor to drive the factories. The power by which this motor is driven is taken from the Cataract Power Company's wires. This is the 10th installation from this company's service into factories in Hamilton up to date.

The Montreal Water & Power Company of Montreal is installing in its pumping station a 400 h.p. S.K.C. two-phase motor operating at 180 r.p.m. This motor is intended to operate the waterworks pumps, and will be driven by current generated at Chambly rapids, a distance of sixteen miles away. This is one of the largest single motor installations in Canada.

The Royal Electric Co. has received an additional order from the Hamilton Electric Light & Power Company for a 500 h.p. S.K.C. two-phase synchronous motor, which is to operate a shaft driving their arc circuits and street railway power circuits. This is an addition to the two 350-h.p. motors noted in these columns recently.

Corley & Collins, Mount Forest, Ont., have experienced such an increased demand for lighting during the past two months that they were compelled to increase their facilities, and have purchased from the Canadian General Electric Co., a standard 1,000 light single-phase alternator, with marble panel switchboard and exciter, to meet these requirements.

There is an application to the Dominion Parliament for a charter for an electric railway from Ottawa, through the township of Nepean, Ont., by Kingsmere to Meach's Lake, in the District of Ottawa, in Quebec; also to construct to Hog's Back and Graham's Bay, in Nepean, and the town of Aylmer and city of Hull, Que.; also to construct a railway, foot passenger and vehicular bridge across the Ottawa River from Nepean to Hull at the Remous Rapids, in the township of Nepean.

R. G. Code, A. F. May, A. Macfarlane, E. F. Burritt, C. T. Moffat, Ottawa, Ont., will be incorporated as the Royal Telegraph Co., Ltd., to build, buy or operate telegraph and telephone lines in any part of Canada. The capital is to be $100,000, and the chief place of business, Ontario.

A trust for electric carbons has been formed in Chicago under the name of the National Carbon Company with a capital of ten millions, and taking in the twelve largest carbon factories on the continent. One of these was said to be the Ottawa Carbon Works, which controls the business in Canada.

E. S. Jenison has completed his surveys for the power canal from Kakabeka Falls to Port Arthur. The reservoir will be on the highlands west of Port Arthur and will cover an area of four thousand acres, with a depth of from fifty to seventy-five feet. Its surface will be three hundred and three feet above Lake Superior.

The London Electric Co., has placed an order with the Canadian General Electric Co. for another No. 12 4-circuit 125-light Brush arc dynamo, and an additional 300-k.w. revolving field single-phase alternator. When these are installed this company will have one of the most complete lighting stations in Canada.

The steamer "Pro Patria," of Halifax, N.S., is being equipped electrically, and for the purpose of lighting the steamer and operating searchlights, an order has been placed with the Canadian General Electric Co. for the complete outfit, which will consist of a standard C.G.E. direct connected equipment, including engine, dynamo, switchboard, searchlight and wiring complete.

Jas. Madden, jr., formerly of Welland, Ont., who recently graduated from the Peterboro works of the Canadian General Electrical works, has been appointed to a position with the Lachine Rapids Hydraulic and Land Company of Montreal, where he has been temporarily located since graduation. His duties are the charge of the switch board of the company and the supervision of the repairs in the company's electrical lines.

The Canadian General Electric Co. has been awarded, by the Department of Railways and Canals, the contract for the erection of a power house, and the complete equipment of the Soulanges canal with electrical apparatus, for operating the locks by means of electric motors. The entire canal, covering a distance of 14 miles, will be illuminated by arc lamps. Owing to the success met with by the Department in the operation of electricity of the canal at Sault Ste. Marie, Ont., as applied to the locks, it has decided to make a more extensive application of the use of electricity, in the illumination and electrical operation of the locks of the Soulanges canal.

The Queen Victoria Niagara Falls Park Commissioners met in Toronto on the 4th inst. to consider amended plans of the proposed works on the Canadian side, which the Niagara Falls Power Company has submitted for their approval. These plans involve the removal of the power-house from just under the bluff, at a point about 200 yards from the street railway power-house, to a site much nearer the river, and close to Cedar Island. This will greatly shorten the intake leading to the power buildings, but will necessitate a much longer tunnel, to a point below the Falls, for the purpose of conveying off the waste water. The commissioners will carefully consider the changes in order to see that the plans do not deface the park and the scenery to a greater extent than those approved of four years ago.

The Canadian General Electric Co. has recently sold to Evans & Hastings, printers, Vancouver, B.C., a 6 k.w. Edison dynamo; to Braid & Co., of Vancouver, B.C., a 10-h.p. motor for use in their spice mills; a 50-light dynamo to be installed in the premises of a customer at Edmonton, N.W.T.; to the Savoy Theatre at Vancouver, B.C., a 250-light incandescent lighting dynamo, of the multipolar slow speed type; to McKenzie Bros., of Victoria, B.C., a 6-k.w. Edison motor; to the British Columbia Electric Railways Co., to be used in driving the blower apparatus in the power house, a 12-k.w. Edison motor; to Hoffmeister Bros., Vancouver, B.C., a 25-light incandescent lighting dynamo; to J. C. Woodrow, Vancouver, B.C., a 3-k.w. Edison motor, and to Hinton & Co., Vancouver, B.C., to be installed on a steamer navigating Lake Bennett, a 25-light incandescent dynamo.

Peterborough is asking the Ontario Legislature for leave to develop water power on the Otonabee River, and supply electric light, heat and power.

Sir William Meredith, B. B. Osler, Q.C., and F. P. Sargent have completed their arbitration in the Grand Trunk telegraphers dispute, and have made an award fixing a time and wage schedule, and providing for over time pay, etc.

Dr. Arthur E. Kennelly, the president of the American Institute of Electrical Engineers, has come to Montreal to deliver a series of four lectures at McGill University. A popular lecture on Submarine Telegraphy was given in the Physics building, McGill, January 30th.

John Philip, Grand Valley, Ont., is supplying the town of Grand Valley and the town of Arthur, Ont., which is thirteen miles away, with incandescent light from his incandescent lighting plant in Grand Valley. He has had such success with transmission plant from Grand Valley to Arthur that he has purchased from the Royal Electric Company a 75-k.w. S.K.C. two-phase alternator, which he is installing in his power station. This will enable him to deliver at least 1,000 lights, wired up, in Arthur, and also to serve everything in Grand Valley. As heretofore noted this is a new departure in lighting, as the power-house depends for fuel upon the refuse from a sawmill, which before the present plant was installed was a nuisance, but is now a valued source of income.

Railway Matters.

Trains are now running from Skagway to Log Cabin over the White Pass Railway.

The C.P.R. car shops at Perth, Ont., are turning out this winter 300 box cars, 60 coal cars and 50 flat cars.

The Lake Erie & Detroit River Railway has decided to erect a new swing bridge over the Thames river at Chatham, Ont.

The preferred stock, $1,000,000, of the Kingston and Pembroke Company, authorized by the Government, has all been subscribed.

Application will be made for the right to build a line of railway from Edmonton to Victoria, and Beaver Lake to South Edmonton, N.W.T.

The Gatineau Valley Railway will be extended this year from Gracefield, the present terminus, to Maniwaki, a distance of twenty-eight miles.

Hereafter the Lake Manitoba Railway and Canal Company will be known as the Canada Northern Railway and a charter secured authorizing the building of a line from Lake Winnipegosis or thereabouts to Edmonton or thereabouts.

George Appleby of Darling's Island, Kings county, N.B., is doing the work on his contract in connection with the I.C.R. improvements of removing the St. John Bridge and railway extension track to such a point as may be deemed advisable.

Application will be made for a charter for a railway from Edmonton, N.W.T., thence via Athabasca Landing and Lesser Slave Lake to Peace River; also to permit the railway company to own vessels and navigate the Athabasca River from Athabasca Landing to the mouth of Little Slave River and up the same into and through Lesser Slave Lake.

The Lake Erie & Detroit River Railway Company has taken over on lease from the United States & Ontario Steamship Navigation Company the car ferry "Shenango No. 1" and the slip docks at Port Dover, Ont., and Conneaut, Ohio, for a term of five years. This means that the Lake Erie & Detroit River Railway Company have secured control of the ferry business on Lake Erie.

R. Patterson has been appointed master mechanic of the Grand Trunk shops at Stratford, vice J. D. Barnett resigned. He was formerly locomotive foreman in that section, and was for some time previous connected with the erecting shops. He was removed from Montreal to Toronto some years ago, and upon the advent of the new management was removed to Fort Gratiot, Mich., as master mechanic of the Chicago and Grand Trunk, succeeding William Roberts.

S. F. Barker, Hamilton, Ont., has been elected president of the St. Louis, Kansas and Southwestern Railway, and J. N. Young, who was the original promoter of the Toronto-Hamilton and Buffalo Railway, has been elected vice-president and manager. Three months ago, Mr. Barker representing Canadian holders of bonds to the value of $800,000, bought the road at auction for $150,000.

The Toronto, Lindsay and Pembroke Railway Company is applying for incorporation to construct a railway from Golden Lake, Ont., to a point on the Irondale, Bancroft and Ottawa Railway, or the Central Ontario Railway, in the county of Hastings, there to connect with the Irondale, Bancroft and Ottawa Railway, or the Central Ontario Railway, or any other railway. To be operated with steam or electricity.

At the present session of the Ontario Legislature application will be made for an Act to incorporate the North Lanark Railway Co., with power to build a line from the Kingston & Pembroke Railway, near Mile Lake, in Renfrew county, to the C.P.R. or O.,A. & P.S. Railway at Arnprior. The route of the proposed road has been surveyed by A. Bell, C.E., of Almonte, acting for a number of capitalists interested in iron mining.

The Canadian Pacific Railway Company intends making application at the forthcoming session of Parliament, says The Vancouver World, for a charter to build a line of railroad from a point at or near Cranbrook or Fort Steele, B.C., on the line of the Crow's Nest Pass Railway, northerly along the Kootenay and Columbia Rivers, to a point at or near Golden, with power to operate branch lines of railway extending from the proposed new line a distance of not more than 30 miles.

It is proposed to build a railway from the outlet of Kamloops Lake; thence by the most direct and feasible route to the plateau of the Bonaparte River; thence to a point on the Cariboo wagon road near the One Hundred-Mile House; thence following generally the route of the Cariboo wagon road to the mouth of Quesnelle River; thence northwesterly, following generally the route of the Telegraph Trail to Hazelton, at the Forks of the Skeena River; and thence north and northwest by the most convenient and feasible route to a point in the vicinity of Atlin Lake; with power to build a branch line to Teslin Lake.

D. C. Fraser, M.P., for Guysboro, N.S., who introduced the British Yukon Railway Bill into Parliament, and who has since visited the scene of the company's operations, says that after completing the track from Skagway to Lake Bennett, 37 miles, they will build 100 miles of road into the Atlin country, joining the Hootalinqua River, and thus securing good navigation to Dawson City. He further says that the line is practically located all the way to Selkirk and that if Canada wishes for it, there is nothing to prevent her from securing the whole of the Yukon trade.

Application is being made for a charter for the Worthington & Onaping Railway Company, with power to construct, lay out, and build a railway from a point at or near Worthington Station, in the township of Drury, Algoma; thence northerly near the Inez mine in the said township, thence northeasterly to the Sultana nickel mine in the township of Trill, thence northerly and easterly a distance of about fifty miles, crossing the main line of the Canada Pacific Railway at or near Onaping Station, and with power to equip and operate the same by steam or electricity.

Vancouver, Northern & Yukon Railway Company is applying for a British Columbia charter to construct a railway from some point at Vancouver, or other point on the shore of Burrard Inlet, thence running in a northerly direction by way of Seymour Creek, to the Squamish Valley; thence through the Pemberton Meadows to Lillooet; thence northerly to Quesnelle; thence northwesterly to Hazelton, or some other point on the Skeena River; and thence northerly to the northern boundary of the province; with power to build a branch line from Hazelton along the valley of the Black River to the northern boundary of the province; with power to build branch lines to Fort St. John; with power also to build branch lines east and west from the main line along the north shore of Burrard Inlet to Howe Sound and the west shore of the North Arm of Burrard Inlet; with power also to build and operate branch lines from time to time to groups of mines and to farming lands from any point on the main line or any of its branches; and to use steam or electricity.

The C.P.R. is to spend $500,000 on its Detroit-Megantic section this season in improvements.

Application will be made for the revival of the charter of the Lindsay, Bobcaygeon and Pontypool Railway Co.

An action has been taken in Toronto by the Alberta Coal & Railway Company against Mackenzie & Mann, the late Yukon railway contractors, the plaintiffs claiming from that firm the sum of $100,000, alleged to be due for rails and rolling stock.

The Algoma Central Railway will apply for an Ontario charter at the next session of the Legislature; the proposed line will run from Sault Ste. Marie, Ont., to the Michipicoten River, thence northerly to the C.P.R., and southerly to Michipicoten harbor on Lake Superior.

Application will be made for the right to build a line of railway from Chute Aux Iroquois, in the county of Labelle, Que., to a point near Lake Nominingue, in the county, and thence to a point near Lake Temiscamingue, and to operate lines of telephone and telegraph alongside the same.

The Kootenay Valley & Burlington Railroad is being built by Foley Bros., Larson & Stevens. The entire distance to be built is 50 miles, and the contract provides for its construction by July 1, 1899. It will require the employment of 5,000 men to complete the work, which will be rapidly prosecuted.

The Deseronto car works are turning out a large order of box cars for the Intercolonial Railway. Each car is of 60,000 lbs. capacity, and will be built of the very best material. The cars will be fitted with Sterlingworth brake beams, Westinghouse air-brakes, automatic couplers, steel trucks, Chicago roofing patent grained doors, etc.

In the financial year just past the Quebec Government gave to the Quebec, Montmorency & Charlebois Railway, $15.191.15; to the East Richelieu Valley Railway, $5,000, and to the Great Northern, $120,093.97. The Government announces that no bonuses will be paid to railways this year, and all the promises of the late Government are repudiated.

Thirty-two years ago Nova Scotia granted the Windsor & Annapolis Railway Company a drawback of duties on materials and stock used for the construction and operating of the road. Parliament in 1896 authorized the extinguishment of the right, and $100,000 has been paid to the Dominion Atlantic Railway Company, successors of the original incorporators, in commutation of it under an agreement signed October 7. The last Gazette contains a proclamation repealing the legislation granting the concession.

Application is being made for an Ontario charter for the Thunder Bay, Nepigon and St. Joe Railway. The route proposed is from Port Arthur via Dog Lake and Black Sturgeon Lake to Black Sturgeon Bay on Lake Nepigon, a distance of 68 miles. A surveying party has returned to Port Arthur after making a preliminary survey. They report finding good country throughout the distance, free from difficulties in construction. The country is level, well wooded with pine, tamarac, spruce, cedar and birch. Fully one-third of the country is occupied by small lakes simply teeming with fish, and there are several million acres of good agricultural land near the upper part of the line. Deposits of limestone and marble, useful for fluxing purposes, iron ore, salt and lignite are said to have been found in the district.

Mining Matters.

The Dominion Coal Co. has closed down the mining works at Bridgeport, Cape Breton.

A Wabigoon, Ont., correspondent gives news of the existence of a large vein of hematite iron ore to the north of Wabigoon.

The Canadian General Electric Co. has recently sold to the Comstock Concentrator, Silverton, B.C., a 25-light Edison dynamo.

J. H. Fraser, Petrolia, driller, has given up for the season prospecting for the Standard Oil Co. in Manitoulin. The exploration will be resumed in the spring.

Hastings county, Ont., felspar is now in demand in England for glazing purposes, and users state that it is much superior to the Scandinavian product now almost exclusively used.

The Canadian General Electric Co. has recently sold to the Athabasca Gold Mining Co., Nelson, B.C., a 100-light Edison dynamo, to be used in lighting the work buildings at the mines.

The Canadian General Electric Company has recently sold to the Scottish Colonial Mining & Milling Co., of Three Forks, B.C., a 100-light 16-c.p. incandescent dynamo, to be used in lighting buildings at the mine.

Work on the Zenith zinc mine to the east of Fort William, Ont., near Rossport, owned by H. J. Beemer, of Montreal, is being pushed. Warehouses have been put up, stables built and the Canadian Pacific Railway have arranged to run a spur track twelve miles out to it.

The Wm. Hamilton Mnfg. Co., Peterborough, Ont., has received the contract for the erection of a 10-stamp mill on the Bend 'Or property in the Bridge River district, B.C. There is ample water power and the company has agreed to have everything in running order by July 1st, 1899.

Sultana Island, upon which is situated the celebrated Caldwell gold mine, has an area of about 500 acres. The Caldwell property comprises 47 acres. The ownership of the balance of the island, known as the Ophir property, has been in dispute since 1889. The Commissioner of Crown Lands has recently given final judgment in the case, and decided that the Ontario Mining Company is entitled to an undivided third of the claim; Margaret Johnston and associates to an undivided third, and the Canadian Pacific Mining and Prospecting Company and the Seybold Syndicate to the remaining third.

There is to be a new graphite company at Grenville, Que., which will be capitalized at $500,000 and is composed of Pennsylvanians. The application for incorporation is now being made. The property at Grenville was worked in 1860, but since then has not been touched. The graphite is said to be 98 per cent. pure and the deposit large. It is the intention of the company to operate at St. Malachi also, where a fine property has been secured. The company will, it is said, erect mills at both places, but at present the work of taking out the ore is all that is being done.

Bay de Verde district in Newfoundland has benefited greatly the past year from the mining boom there, says The St. John's, Nfld., Herald, and is likely to enlarge upon this during the present season. The Iron Co. has named its headquarters Workington, and has 16 square miles of territory under lease, all of it said to be rich in this mineral. They have two shafts sunk near there, two others at Island Cove and a fifth at Northern Bay. Stores, offices, sleeping quarters, and messhouses have been built, and a railway is laid to Perlican, so that there is every assurance that the property will be worked to the fullest possible extent.

A considerable deposit of kaolin—used in the manufacture of china—has been found to exist at Plow Rapids near the mouth of Stag Creek on the Gatineau. The place is about 40 miles from Ottawa and is owned by an Ottawa man. The kaolin was discovered first in 1860 by the late W. L. Holland. Samples of the material were later on sent to St. John's, Quebec, and to the United States where it was successfully used. It should be possible to successfully make use of this deposit in a country where electrical power is limited only by the amount of apparatus set up, the water power being unlimited.

The American Copper Mining Company, in its combination of six plants, expects, it is said, to control the copper mining industry of the world. The Boston and Montana and the Butte and Boston mining companies, the old Dominion Copper Company of Arizona, and the Arcadian, Tamarack & Osceola Mining Companies of Michigan are named as the component parts of the new organization. It is understood that the American company will reach into Canada and absorb important copper mines there, thus making the combination international, but the Calumet and Hecla Company, the largest producer in the Lake Superior region, has so far declined to enter the combination.

War Eagle Gold Mining and Development Co. has received a refund of $16,000 from the Trail, B.C., smelter, on account of the mine having furnished the stipulated 175 tons of ore daily for the past six months. During that time the shipments amounted in round numbers to 32,000 tons, and the refund was on the basis of 50 cents per ton. The War Eagle smelter rate is $7 per ton.

Marine News.

Nicholas and Michael Connolly have secured the contract from the Department of Railways and Canals to build a large wharf for the I.C.R. terminus at St. John, N.B.

It is now said that the "Pharsalia," the latest addition to the battle line, will be launched at an early day. Captain Smith of Yarmouth, N.S., and formerly in the "Arbela," will command her.

The White Star Line steamer "Oceanic," the largest ship ever built, was successfully launched at Harlan & Wolff's yard, Belfast, Ireland, January 14th, in the presence of an enormous crowd. A grand stand was specially erected to accommodate 5,000 persons.

Incorporation is being sought for a company to construct a canal or ship canal for navigation from some point on Lake St. Clair, in the county of Essex, or in the county of Kent, to some point on Lake Erie between Point Pelee and Rondeau Harbor.

G. N. Ducharme, Ste. Cunegonde; M. F. Pauze, Montreal; A. A. Bernard, M.D., St. Henry; L. A. Bernard, Montreal; T. Bienvenu, Labelle, Que., are to be incorporated as the Lake Labelle Navigation Co., Ltd., Montreal. The capital of the company will be $10,000.

R. Roy, Dominion engineer, has started a large gang of men to work to improve the navigation on the Kootenay River from Fort Steels to Wardner, for which a grant of $5,000 has been given. The bulk of the work will be done on Wild Horse bar, which is the worst impediment to navigation.

The Richelieu and Ontario Navigation Company will put on a daily service up the Saguenay next summer and the Hamilton service will be augmented by additional vessels. The steamer "Saguenay" will be renovated this winter and new boilers and electric plant will be introduced.

The latest addition to the fleet of the Dominion Atlantic Railway steamers, the "Prince George," is proving a very fine ship; she has now been making regular trips for some time between Yarmouth and Boston. The sister ship, "Prince Arthur," now building at Hull, Eng., will probably be placed on the route in the spring.

A further proviso has been added to the contract with the Allan and Dominion steamship companies for the Atlantic mail service, by which the vessels of these companies will be required to await at Halifax the arrival of the Chinese mail, which by special contract with the Imperial Government is carried by the Canadian Pacific Railway.

At the annual meeting of the Great Northern Transit Company it was decided to build a modern steamer for the Sault Ste. Marie route to replace the "Pacific," which was recently destroyed by fire. It was also decided to purchase a new steamer for the North Shore route, to replace the "Belle," also destroyed during the past season.

Recently the Quebec Harbor Board granted an exemption from harbor dues to any ocean steamship line which would make it a regular port of call, and the Elder-Dempster Line made a contract. The board has also given permission to the Great Northern Railway to erect on the quay an elevator, with a capacity of 1,000,000 bushels, to be finished by May 1, 1900.

At the annual meeting of the Canadian Marine Engineers' Association the following officers were elected: Hon. president, O. P. St. John; president, Harry Parker (acclamation); 1st vice-president, A. J. Woodward; secretary, S. A. Mills; treasurer, H. Brownley; inside guard, H. Bowler; auditors, D. L. Foley and E. J. O'Dell; council, Thomas Good, William Horwood, Rees Binch, P. J. Carr and J. E. Kane, Port Dalhousie.

The Polson Iron Works Company, Ltd., Toronto, has been given the contract of building for the Richelieu & Ontario Navigation Co. a new boat, which will be a steel screw craft, 112 feet long, 22 feet 6 inches beam, to draw 6 feet of water, and to make a speed of 15 miles an hour. She will be fitted with a fore and aft compound engine and a Fitzgibbon boiler. The price is said to be $20,000. The steamer will be especially adapted for river service.

The Canadian Marine Engineers' Association held its fifth annual "At Home" in the Confederation Life Building, Toronto, February 1st. O. P. St. John, hon. president, occupied the chair and made an interesting and instructive speech on the advantages of education along technical lines to the engineer. A very good concert was given and a pleasant dance and excellent supper concluded the evening's pleasure. Among those present besides the members were noticed: J. R. Dillon, Hamilton; E. W. McKean, Sarnia; Wm. Lewis, Owen Sound; Capt. Rees, Kingston; D. McEvoy, Gutta Percha Mnfg. Co., Ltd., Toronto; A. W. Smith, Aikenhead Hardware Co., Toronto. The committee in charge of the arrangements were: O. P. St. John, H. Brownley, D. F. Campbell, T. Crossley, S. A. Mills, D. Foley, E. Abbey, H. Bowles, A. J. Woodward.

Personal.

Angus G. Macdonald, city electrician of Halifax, N.S., is dead.

Samuel Hall, one of the oldest employees of the Grand Trunk Railway at Belleville, Ont., died Jan. 4th.

James Cunningham, an engineer on the M.C.R., dropped dead in the Queen's Hotel, St. Thomas, Jan. 6th.

W. R. Campbell, general manager of the Dominion Atlantic Railway, died suddenly in London, Jan. 8th, after a short illness.

R. Patterson has been appointed master mechanic of the Grand Trunk shops at Stratford, Ont., in place of J. D. Barnett, resigned.

R. J. Armstrong, Fort William, travelling inspector of fuel and engines on the C.P.R., has had his office transferred to Winnipeg.

Capt. Thos. Donnelly, Kingston, has been appointed inspector for Lloyds, and will at an early date resign his position as Government steamboat inspector. The new position is worth $2,000 a year.

Yorke Kirton, formerly of the Lancaster Machine Works, and who has spent the past eight months in the employ of John Bertram & Sons, Dundas, Ont., is now employed in the cotton mills at Valleyfield, Que.

Lieut. Adams, R.E., formerly of Kingston, Ont., and a graduate of the Royal Military College, has been appointed to the important and lucrative position of manager of the Nile Delta Light Railway.

Ronald T. McDonald, the late president and general manager of the Fort Wayne Electric Corporation, while on a business trip to New Orleans, La., and Dallas, Texas, contracted a severe cold, which resulted in double pneumonia, causing his death December 24th.

E. A. Wilmot, Mem. Can. Soc., C.E., city engineer Victoria, B.C., was dismissed by resolution of the city council, January 26th. To be dismissed by this particular municipal council is no reflection on Mr. Wilmot's professional status, it is of course understood.

J. A. Sarvis, lately of Fort William, Ont., has been engaged as traveller by the B. Greening Wire Co., Hamilton, Ont. He will represent the firm in northern Ontario, thus allowing the secretary of the company, Mr. R. H. Merriman, to devote more time to the office.

John C. Gardner, late secretary and manager of the Canadian Manufacturer Publishing Co., Ltd., has been appointed president and managing director of the Might Directory Co., of Toronto, Ltd., vice J. M. Might, retired. Mr. Gardner has had a long experience in the directory business, having been some eight years in that special field before he went with the Canadian Manufacturer.

W. C. White, who is well-known in business circles in Montreal, died at his residence there a short time ago. Mr. White was a manufacturer of boilers and lead pipe. He was born at Paisley, Scotland, in 1829, and came to Montreal in 1853. In 1860 he became a boiler and boat builder, and at the time of the construction of the Victoria Bridge was a sub-contractor. Mr. White was the proprietor of a manufacturing establishment at Sorel, and there built a number of vessels for the Richelieu and Ontario Navigation Company.

The report of the death of Lieutenant Keating, son of the general manager of the Toronto Railway Co., shows that he sacrificed his life in an effort to save a wounded corporal. It was in the fight near Yelwa, on the Niger, and the little British force consisted of Lieutenant Keating, Corporal Gale and fourteen native soldiers. Corporal Gale was shot by the blacks, but Lieutenant Keating by cutting down several of the boldest of them brought the badly wounded corporal to the river bank. When helping him into the canoe the fatal shot was fired from a close ambush.

LITERARY NOTES.

A. O. Norton, Boston, Mass., U.S.A., has issued a very complete catalogue of his patent ball-bearing jacks and "Sure Drop" track jacks.

The proceedings of the eighth annual convention of the Association of Railway Superintendents of Bridges and Buildings have been issued in a volume of nearly 300 pages.

The 21st annual edition of the Maine Record, Cleveland, O., U.S.A., was published January 26th and comes to hand with 52 pages of advertisements and interesting reading matter.

The Standard Tool Co., Cleveland, O., U.S.A., which makes a specialty of electric welding, has forwarded us a catalogue of the electrically welded bicycle parts, which are a well known product of this firm.

At the October meeting of the American Institute of Mining Engineers, H. H. Stock read a paper on the history of the International Correspondence Schools, Scranton, Pa., U.S.A., which has now been issued in pamphlet form.

The Mechanics Supply Co., Quebec, has just issued catalogue "M," which deals exclusively with acetylene gas fittings, etc. This is commendable enterprise, as it is the first catalogue of acetylene gas fixtures which has reached us.

The Hamilton Bridge Works, Ltd., Hamilton, Ont., has many points of interest in its 1899 catalogue just received. The illustrations showing the various recent works of the firm are very well done. The catalogue will be sent free on application.

Charts for Low Pressure Steam Heating for the use of engineers, architects, contractors and steam fitters is the title of a very comprehensive publication prepared by J. H. Kinealy, D.E., Mem. Am. Soc. Mech. Eng., and Am. Soc. Heating and Ventilating Engineers. We shall make further reference to this valuable work.

The Model Engineer and Amateur Electrician has reached us from London, Eng. It is a journal of mechanics and electricity for amateurs and students.

The Technology Review has just issued its first number. It is a quarterly magazine relating to the Massachusetts Institute of Technology, and is published at 71 Newbury street, Boston, by the Association of Class Secretaries.

The British Fire Prevention Committee has just issued as No. 12 of its official publications, the Effect of Fire, which is a report on the Horne building fire in Pittsburg, U.S.A., by G. Kaufman, C.E.; E. Swenson, C.E., and F. L. Garlinghouse, C.E.

The Canadian General Electric Co. has issued a handsome calendar for 1899, which is decorated with a picture of a female figure operating an electric search light whose rays fall upon the extensive works of the company at Peterboro, and show up brightly that huge industrial hive.

We have before us the profusely illustrated catalogue of the Unbreakable Pulley and Mill Gearing Co., Ltd., West Gorton, Manchester, Eng. It is a most valuable work on power transmission, entitled the Economical Transmission of Power, and contains over 150 pages of the most condensed information, many pages of statistics and other tabulated facts, which are of interest to all users of power.

We have received a circular from the Committee of Organization and Administration of the Congreso Industrial of Argentino, Lorea 80. It is proposed to hold an Industrial Exhibition at Buenos Ayres, capital of the Republic, in the month of May next. Exhibits will not be received after April 15th. Foreign exhibitions besides receiving diplomas without cost will have all the rights in connection with the exhibition that belong to natives of the country.

It is proposed to hold at Toronto in May an Historical Exhibition under the auspices of the Ontario Historical Society. The exhibition is intended to be both attractive and instructive, to illustrate the history of Ontario in particular, during the century now ending, and to demonstrate the progress of our people along commercial, social and intellectual lines; the history of localities as well as of the entire province; the advancement made in social and domestic comforts; and in scientific and domestic economy. It is not intended, however, to confine the exhibits to Ontario, although it should be given first place, but to include anything relating to the history of Canada. The Ontario Historical Society has already available the nucleus of such an exhibition, and it is believed that the various local societies and a large number of generous citizens will lend enough additional material to make this one of the most comprehensive and representative exhibitions of the period. All exhibits loaned will be properly taken care of and their safe return guaranteed. The proceeds of the exhibition are to be devoted towards the establishment of a permanent historical museum. Miss Fitzgibbon, 1 Avenue Chambers, Toronto, is the secretary of the exhibition committee.

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For The Canadian Engineer.

RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

ARTICLE 3.—TIES.

Ultimately we may expect metal ties to take the place of wooden ones. In Europe, with dear wood and heavy traffic, substantial progress has already been made. In America experimental pieces of track have proven satisfactory in cheapening maintenance, and for many reasons, to be enumerated, we may expect progress to be considerable in the near future, but for many years wooden ties will continue, on this continent, to be the rule, and metal ones the exception, although their use constitutes a heavy drain on our forests, which probably amounts to six or seven million ties per year for Canada alone.

Wooden Ties.—Wooden ties are in general use because they are cheap, and simple in use or renewal, and by the use of preservatives their life may be increased considerably. In Belgium and adjacent countries where mild steel ties are in use, wooden ties are being abandoned in favor of steel ones on the following grounds:

(1) That their price will gradually rise owing to the devastation of forests.

(2) The quality of even the best varieties of wood is variable and an unknown factor, being affected by time of felling, place of growth, seasoning, etc.

(3) Preservative methods fail to produce a uniform material for use.

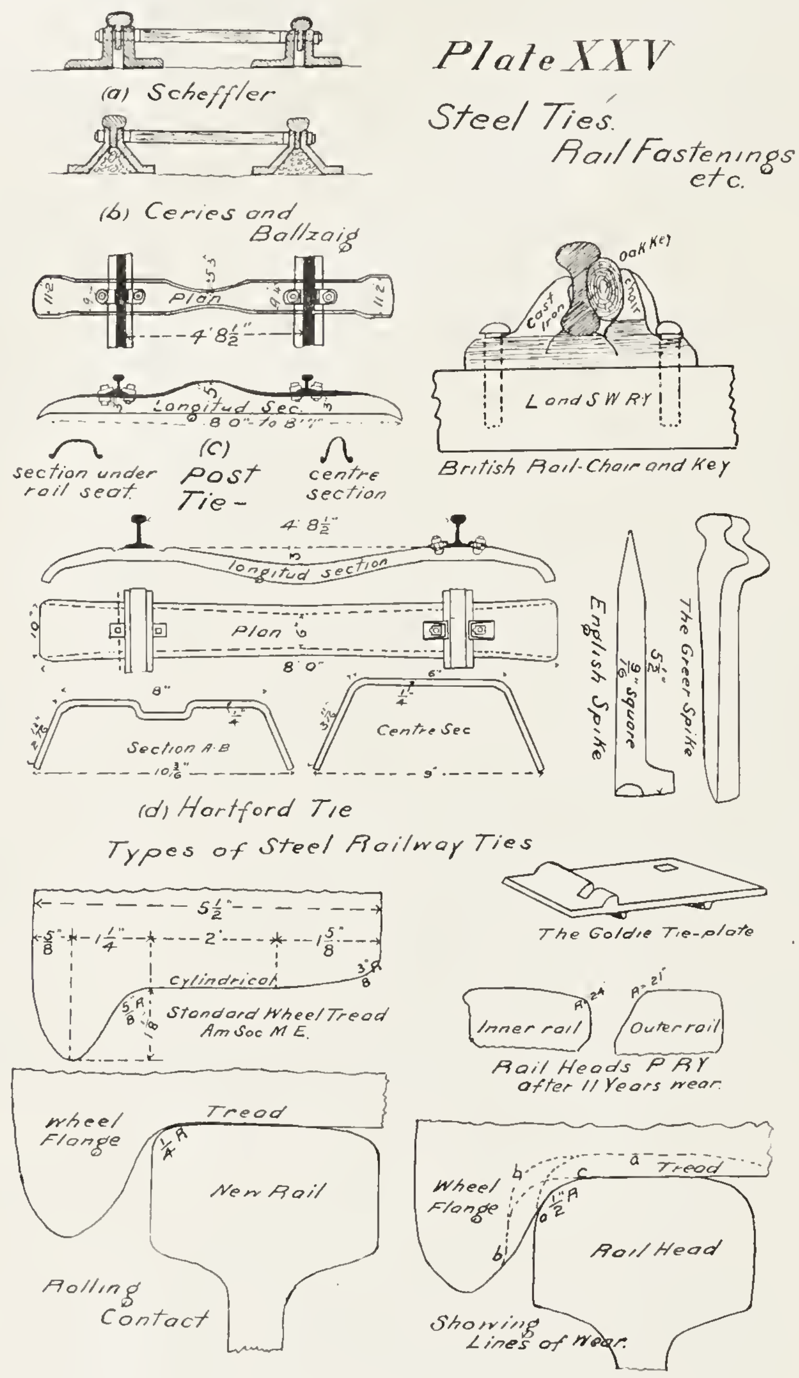
(4) No timber merchant will guarantee ties of wood, while two-year guarantees can be obtained for steel ties.

(5) There is a loss of interest, due to stacking wooden ties for seasoning, whereas steel ties may be in use, legitimately, even before being paid for.

(6) The difficulty of obtaining a good fastening of the rail to wooden ties, and the constant re-spiking necessary.

(7) The selling price of old wooden ties is less than metal ones even in proportion to their first cost. All of these objections are more or less valid, even in America, but the lasting and holding qualities are most important. Ties are ordinarily 8 ft. to 8 ft. 6 inches long, 6 to 7 inches thick, and 6 to 9 inches wide on top and bottom. They may be hewn or sawed, the former method producing a more durable tie if not hacked too deep before hewing. The top and bottom faces of a tie should be true and parallel planes, all bark being removed, and in sawed ties the removal of sapwood on the sides will add to their durability. They are usually laid 2 feet centres (2,640 per mile). The two ties at an ordinary angle-bar joint being selected as the widest ones near at hand and placed about 18 inches apart, centres, centrally about the joint, giving a suspended joint, but if the long six-bolted 44 inch angle-bars are used, then three ties are placed at a joint 18 inches apart, centres, one at each end and one in the middle; otherwise it is considered best to sort ties into groups of nearly the same width. It is believed that a random mixture of ties of various widths tends to cause poor track, as the narrow ones will sink more than the wider ones.

Ties are made from lignum vitæ, oaks, chestnut, locust, cedar, pine, maple, cherry, red elm, hemlock, tamarac, beech and spruce, being named, roughly, in order of durability in track, without treatment by preservatives. The life of a wooden tie in track, untreated, varies from 4 to 6 years for the poorer kinds, up to 10 or 15 years for the more durable ones, except lignum vitæ, which lasts 30 or 40 years. The length of life will depend on locality of growth, the kind and amount of ballast used, drainage, amount and speed of traffic, whether the tie is on a curve or tangent, and finally whether the rail rests directly on the tie or on a tie-plate or metal chair of some form. The wear on curves is greater than on tangents, due to the cutting into the ties of the rail base, which accelerates the rot; also, respiking is more frequent on the former; taking the life of a tie on a tangent as 9 years, one on a 2° curve will last about 8 years, 6° curve 7 years, 15° curve 5 years. Softwood ties can scarcely be used in America, owing to the poor hold of the ordinary dog-spike, which cuts and crushes the fibers of soft woods, while with hard woods the fibers are only squeezed back and are still elastic; but in England, with large metal chairs, soft-wood ties are in general use, and attempts have been made here to use cedar alternately with oak, as they both last well, and the latter will hold the spikes; also attempts have been made to nail oak planks on top of soft-wood ties, dove-tail oak bearing pieces just under the rails, and in other ways dodge the main issue, which is the poor holding power of the spike, but none have been very successful. Metal tie plates such as the one shown on Plate XXV. are now used on heavy traffic roads, sometimes only on curves, and latterly under all the track. These spread the load over a larger surface, and are a great improvement, as they enable a cheaper tie and a deeper rail, relatively to its width of base, to be used. When railway managers in America see the wisdom of adopting wood screws or fang bolts, as in England, for holding the rails in place, a much superior track will be obtained even at a small increase of first cost.



There are several ways of increasing the ordinary life, in track, of a wooden tie, for a tie rots by the solidification of fermented sap, assisted by heat or dampness:

(1) By thorough drainage of the ballast.

(2) By having as little sap as possible in the tie by felling the tree in winter, and subsequent natural, steam, or other form of seasoning.

(3) By charring the surface.

(4) By impregnating the tie with an antiseptic to prevent fermentation.

Such chemicals as sublimate of mercury, sulphate of copper, chloride of zinc, and creosote or oil of tar, serve the purpose more or less successfully, especially the last two, and the last one most particularly. Creosoting is done in a closed receiver, after the tie has been air seasoned two or three months, and trimmed of its sapwood, by exhausting the air to suck out the sap from the pores of the wood. Creosote at 120° F. is then forced in at 10 atmos. pressure, and after one hour the ties are taken out ready for use; soft woods, which are the only ones usually treated, absorb 7 to 9 lbs. per cubic foot, and the cost of treatment has been reduced from 21 cents in 1879 to 10 cents per tie at the present time. The increase in the life of ties in track is greatest amongst soft woods according to the following table:

Timber.	Duration in track.	
	Untreated.	Creosoted.
Oak	13	19
Pine	7	15
Fir (Spruce)	5	9
Beech	3	16

Creosoted ties will not resist the cutting of rails more, nor are they stronger than untreated ones, but, especially in thickly settled countries, discarded ones will be more valuable as fence posts or fuel, being worth from $\frac{1}{5}$ to $\frac{1}{10}$ of first cost.

Creosoting does not assist ties to hold spikes, and in this respect wooden ties are deficient. Spikes with hardwood ties on roads of moderate traffic are one thing, with soft-wood ties or with any tie on heavy traffic roads are another. As they are continually being pulled loose by the action of passing trains, and have to be redriven, in the future, with heavier traffic, rails and engines, something must be done to remedy this weakness of American track, the solution of which will lie along two lines, either metal ties and appropriate fastenings, or oak or other durable ties along with tie plates, and fang bolts or wood screws as fastenings—either method will allow deeper rails to be used, or ties spaced farther apart.

Metal Ties.—Three types of metal rail-supports are used:

(1) Longitudinal flanged sleepers giving a continuous support to the rail, and held to gauge transversely by rods; sections of these are shown on Plate XXV. (a) and (b); they have never come into anything like general use.

(2) A succession of cast-iron inverted pots, filled inside with ballast and connected transversely by rods, as in class (1); this method has been used in regions of brackish soils where cast iron rusts less than steel, and can be made heavier, as it is a cheaper material; this method is also only in limited use.

(3) Metal cross ties of inverted trough sections are steadily increasing in favor and are likely to obtain, in the future, general adoption.

The tendency of metal cross-ties is to decrease maintenance charges year by year, while with wooden ones, especially on curves, the reverse is the case. Of these the Post tie seems to be the favorite in Europe; on the Netherlands railway, maintenance with metal ties was about one-half of what it was with oak ones, with thirty trains per day and engines of fifty tons, and no ties reported broken. A sketch of this tie is given on Plate XXV. (c); it is of mild steel, weighing 110 to 120 lbs. each, and costing a few years ago $22 to $26 per short ton, with two year guarantee. It is closed at the ends, narrow and deep at the middle, with thickness varying, being greatest at rail seats; the bottom edges are in the form of ribs ¾ inch thick, projecting ½ inch. The general thickness is ¼ to ½ inch. The narrowing in and deepening at middle gives transverse strength, and prevents the track from creeping longitudinally, or forming a hog back at the centre. The rails are fastened by bolts with T heads and eccentric necks. These bolts pass through the tie from underneath, and into a crab washer which bears on the rail flange and tie; a Verona nut-lock and a nut complete the fastening, and an oblong hole through the ties allows adjustment on curves. This tie presents economy of material and maintenance and general efficiency. It has been in long, extensive use in Belgium, Holland and France, and is probably the best metal tie yet devised for flanged rails. In the United States the Hartford tie has been used with good results on the New York Central, and it appears in general to be an imitation of the Post tie, with an endeavor to simplify manufacture, see (d) Plate XXV. Other forms of less tried qualities are the Standard, an inverted channel beam, and the International, having a section like an elongated bracket ——┴——, which would appear to be deficient in vertical stiffness. It is probable that persistent attempts at improvement will have a tendency to cheapen manufacture, and hasten the introduction of metal ties on many progressive railways having heavy traffic.

(*To be continued.*)

For THE CANADIAN ENGINEER.

SEWERAGE SYSTEMS OF ONTARIO.

BY WILLIS CHIPMAN, C.E.

The following tabular statement gives the extent and cost of the sewerage systems of the Province, excluding those of the cities of Toronto, Ottawa, Hamilton, London and Kingston.

	Population	Miles Sewers	System	Approximate Cost	Engineers
Barrie	6,000	3½	Separate	$ 27,000	Chipman, Ardagh
Belleville	10,000	5	S. & C.	65,000	Neilson, McDougall
Berlin	9,500	10	Separate	69,000	Bowman, Chipman*
Brantford	17,000	14	Separate	134,000	Chipman. Jones, T.H.
Brockville....	9,000	11	Separate	121,000	Chipman
Chatham	10,000	18	Combined	95,000	McDonell, McGeorge Topp
Cornwall	7,000	7	C. & S.	55,000	Chipman, Wiggins, Brown
Goderich . ..	4,000	4½	Separate	19,000	McDougall,† Brough
Niagara Falls.	5,000	11½	Separate	105,000	Mitchell, Chipman,†
Owen Sound..	8,000	7¼	Combined	48,000	Kennedy, McDowell
Peterborough .	11,000	7½	Separate	70,000	McDougall, Belcher
Petrolea	6,000	6	Combined	45,000	Jones, J. H.
Renfrew ..	3,000	4	Separate	20,000	Chipman
St. Catharines	10,000	6	Combined	70,000	Gardiner, Reynolds, Roberts
St. Thomas ..	11,000	46	Combined	150,000	Bell, Campbell
Sarnia	8,000	7	Combined	26,000	Jones, J. H.
Sudbury	1,400	1¼	Separate	10,000	Gordon, Rorke
Stratford	10,500	8½	S. & C.	70,000	McDougall, Van-Buskirk
Tor. Junction.	5,000	11	Separate	120,000	Chipman
Walkerville ..	2,500	4½	Combined	50,000	DeGurse
Waterloo	3,000	3½	Separate	20,000	Bowman, Chipman*
Welland	2,500	1½	Combined	7,200	Ross
Windsor	12,000	21	Combined	280,000	DeGurse
Woodstock...	9,000	11½	Separate	50,000	Davis

In those places where the separate system has been adopted, the sewers are modern in design, and have been constructed during the last ten years under the supervision of competent engineers.

In some places the sewers have been built street by street and year by year without reference to any general plan or system, and occasionally without the advice or assistance of an experienced engineer. In some few places a large amount has been expended, but to the present time they have few, if any, proper sanitary sewers.

Class A.—Barrie, Berlin, Brantford, Brockville, Niagara Falls, Renfrew, Toronto Junction, Waterloo.

Class B.—Cornwall, Goderich, Peterborough, Owen Sound, Sarnia, Sudbury, Walkerville, Windsor.

Class C.—Belleville, Chatham, Petrolea, St. Catharines, St. Thomas, Stratford, Welland, Woodstock.

In Class A have been included those places in which the majority of the citizens are now served with well built, properly designed sanitary sewers; and where all plumbing work and the laying of house sewers are done according to stringent rules and regulations under the city or town engineer's inspection, and full records kept of all such work. These are undoubtedly the best sewer systems in Ontario, not excepting the five largest cities of the province. Drains of wood and stone are excluded from these systems.

In Class B some of the places have almost complete sanitary systems, but they have no regulations or rules whatever governing plumbing, and no complete records are kept of work done. The other places in this class have partial systems now built, covering the majority of the streets, but the plumbing by-laws are very imperfect. Drains of stone and wood are also excluded from class B.

In class C have been placed: (a) Those places that have constructed a very few sewers or a main sewer, but in which the great majority of the streets have at present no proper sanitary sewers. The work done has been of a modern character, but only a commencement has been made towards a first-class sewer system. (b) Those places in which a large part of the expenditure represents the cost of box drains and sewers that cannot or should not be used for sewage purposes. It must not be inferred, however, that all of the places in class C are not, on the whole, as well sewered as those in class B.

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* Consulting Engineer only.
† Designing Engineer only.

ROPE TESTING.*

BY GEO. A. M'CARTHY AND ERNEST G. MATHESON.

(*Concluded from last issue.*)

EXPLANATION OF THE TABULATED RESULTS.

The ropes are arranged in the table so that those of the same order are grouped together, and the results are the more readily comparable. Under the column, "Position of fracture":

U is an abbreviation for Upper.
L " " Lower.
T " " Thimble.
S " " Strands.
P " " Pin.

Where no mention is made of the number of strands broken, one strand is to be always understood. The extensions in most cases were taken over a distance of eighteen inches. In testing some of the wet specimens, however, the stretch was so great and the travel of the machine so limited that twelve inches was all that could be allowed over which to take the extensions. In the results no distinction is made between the percentages obtained from these two different lengths. In tabulating the position of fracture as centre, it is not to be taken that this fracture occurred exactly in the centre of the specimen; but was far enough from the fixtures at either end so that no damage could possibly result to the fiber. Therefore we can at once assume that wherever in the tests, a "centre" fracture is recorded, we in that case at least develop the absolute maximum strength of the specimen. The time of the test is given from the moment the load was applied to the specimen to the time when rupture occurred. The time of immersion in water before the wet test was made varied from forty-eight hours to one week, depending on the size and quality of the rope; the idea being to have the rope at least thoroughly wetted.

In the soaked tests, the ropes were in water on an average of about six weeks. The column showing the number of twists per foot is given instead of the "percentage of hard," which is referred to in the short description of the manufacture of rope.

Sufficient comparisons are here given to show that no regularity exists between the strength of one strand of a rope and the strength of three or more strands when they are formed into one rope. The result follows that if we have a rope of two strands and also one of four, we have no good reason for assuming that the one of four strands will be twice as strong as the other. The greater strength proportionately of one strand above two and two above

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*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in THE CANADIAN ENGINEER.

TABULATED RESULTS.

DESCRIPTION OF ROPE.							DRY TEST.				WET TEST.				SOAKED TEST.			
MATERIAL.	No. of stra'ds	Yarns per strand.	Cir-cumference.	Weight per foot.	Twists per foot.	No. of feet of yarn per lb.	Load.	Per ct. of stretch.	Position of fracture.	Time in Min.	Load.	Per ct. of Stretch.	Position of fracture.	Time in Min.	Load.	Per ct. of Stretch.	Position of fracture.	Time in Min.
Manilla	3	11	2"	.124	6	360	3200	12.5	At tack in centre	17	4875	19.0	At U. T.	15	4800	22.0	On L. P.	15
"	3	14	2.25	.156	6	360	3900	10.8	At U. toggle	12	6000	17.2	" "	12	5950	21.7	2. S. at L. T.	10
"	3	17	2.5	.179	5.6	360	5150	12.5	At U. T.	18	7175	20.8	" "	14	7025	20.2	At Centre	15
"	3	20	2.75	.246	5	360	6400	13.1	At U. toggle	17	7950	25.4	" "	15	8050	24.3	On U. P.	13
Tarred manilla landyard, "Good Current"	4	15	2.5	.192	6	575	4400	16.9	2. S. at L. T.	20	5520	20.3	2, S. on L. P.	20	5400	21.7	2. S. on U. P.	15
" " " " "	4	23	3.0	.278	5	575	6550	14.4	On L. P.	20	7250	18.7	" " "	20	6900	18.7	2. S. on L. P.	13
Tarred hemp landyard	4	16	3.0	.332	4.5	360	4800	12.2	2. S. on U. T.	7	4900	10.2	3. S. on U.P.	12	4700	13.8	On L. P.	20
" " "	4	28	3.0	.338	5	575	5250	8.6	3. S. on U. P.	20	6000	10.8	2. S. on U.P.	14	5150	11.3	2. S. at U. T.	20
Manilla boltrope	3	17	2	.113	6	575	3400	8.3	At U. T.	12	5425	18.6	On L. T.	13	6175	20.3	At U. T. At L. T.	10
" "	3	27	2.5	.184	5.3	575	7000	12.2	" "	25	9250	18.6	At U. T.	17	9500	19.6	2. S. on U. P.	12
" "	3	38	3	.265	4	575	8300	10.8	At U. toggle	15	12510	25.4	On L. P.	25	13600	18.3	At L.T.	15
Manilla boltyarn	3	27	2.5	.195	5.3	575	5560	13.1	2. S. on U. P.	25	7600	20.3	2. S. at L. T.	13	6535	20.8	At Centre	17
" "	3	38	3"	.290	5	575	8100	15.3	On L. P.	12	10050	23.3	At L. T.	15	8100	25.2	On L. P.	15
Manilla	3	2	0.9	.018	15.6	400	425	10.6	On L. P.	20	750	15.8	At L. T.	12	880	19.7	Centre	10
"	3	3	1.0	.014	13.3	400	800	8.6	On U. P.	15	1170	19.1	At upper tack	14	1025	20	"	8
"	3	4	1.1	.035	12.3	400	1050	11.1	At centre	14	1450	16.6	At U. T.	7	1500	18	"	10
"	3	2	1.0	.021	15.6	360	700	8.0	At centre	15	825	16.6	At centre	6	900	18.8	At U. T. & Centre	8
"	3	3	1.2	.034	12.6	360	900	11.1	At U. T.	20	1525	20	"	8	1375	22.8	Centre	12
"	3	4	1.4	.037	10.3	360	1100	10	At centre	15	1800	21.9	At U. T.	8	1825	21.0	"	12
"	3	5	1.5	.048	9	360	1650	10.3	At L. T.	16	2300	18.3	At lower tack	11	2550	21	"	10
"	3	6	1.65	.063	7.6	360	2175	15.0	At centre	7	2875	21.7	At L. T.	10	2750	20.4	At L. T.	12
"	3	7	1.6	.064	7.3	360	2450	9.4	"	15	3100	18.2	At U. T.	13	3175	19.6	Centre	13
"	3	8	1.8	.075	7	360	2450	10.8	At U. Toggle	15	3650	19.4	" "	10	3700	23	At L. T.	10
Tarred manilla	3	2	1.0	.021	14.6	360	600	5.5	Centre	14	755	11.7	At centre	11	950	17.1	Centre	12
" "	3	2	1.25	.034	13.6	360	850	8.3	"	12	1200	16.1	On U. P.	25	1275	19.2	"	10
Tarred manilla boat hawser	3	12	2.15	.105	6.6	375	1950	17.5	At U. T.	15	2650	24.4	At U. T.	30	2820	25.8	Whole rope at U.T.	27*
Sisal "oiled"	3	2	1.15	.024	13.6	360	650	14.4	At centre	25	600	24.7	At centre	20	600	28.3	Centre	11
" "	3	3	1.25	.028	12	360	750	10.7	On U. P.	15	750	18.8	At U. T.	15	800	22.2	2 S. at Centre	8
" "	3	4	1.5	.041	9.6	360	1100	9.6	At centre	12	1050	28.8	" "	12	1000	22.2	Centre	10
Tarred hemp ratline	3	2	1.0	.022	13.3	..	460	4.7	2. S. at centre	12	400	8.6	On L. P.	5	590	9.4	At L. T.	9
" " "	3	3	1.23	.036	12	..	850	5.5	2. S. at L. T.	10	750	12.8	At Centre	7	800	12.5	At Centre	9
" " "	3	4	1.44	.052	10.6	..	1000	8.6	At L. P.	10	1000	13.8	2. S. at lower tack	10	1075	13.1	At L. T.	8
" " "	3	5	1.5	.063	8.6	..	1100	7.5	At L. T.	10	1300	12.5	At U. T.	15	1120	13.3	At Centre	8
" " "	3	7	1.7	.09	7.3	..	1350	6.1	At U. T.	10	1433	14.4	At L. T.	15	1450	13.9	"	10
Tarred hemp boltrope	3	2	84	.022	12	..	525	3.1	2. S. U. T.	10	600	9.4	At U. T.	12	800	12.2	At Centre	10
" " "	3	4	1.08	.027	11.3	..	700	5.3	" "	10	740	10.0	At centre	11	700	15.3	"	8
" " "	3	5	1.16	.034	9.3	..	650	5.3	2. S. at Centre	10	800	11.1	"	12	900	11.9	"	8
" " "	3	6	1.2	.042	9.3	..	925	6.6	" "	12	1000	12.2	"	15	1050	12.5	2. S. at L. T.	7
" " "	3	11	1.7	.08	7	..	1500	8.3	2. S. at U. T.	13	2000	12.8	At U. T.	12	2025	13.1	At U. T.	12
Tarred hemp boat hawser	3	12	1.9	.108	7.3	..	1375	11.7	" "	11	1950	20.8	2. S. at centre	15	2125	21.6	2. S. at U. T.	10

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* In this test had to run machine back owing to stretch.

three is no doubt due in some measure to the strands after the first breaks becoming more nearly straight, thus enabling the stress to act along the direction of the length of the fibers. The three strands were broken where rupture took place near the centre of the specimen, so that we got the absolute strength. In the ropes which contained the greatest number of twists to the foot, the irregularity between the comparative strength of three strands, two strands, and one strand was the most noted. This would appear to bear out the deduction just referred to, namely, that the proportionately less strength of three strands as compared with two, and one, is due to some extent to the less twist per foot in the two strands, and one strand, after the first and second strands break.

REMARKS ON EXTENSION CURVES.

The extensions shown on the curves are (for diagrams of these curves, see CANADIAN ENGINEER for February) the amounts the ropes stretched under the different loads in a distance of eighteen inches. In the same diagram each of the three curves gives the average results of the untarred or tarred rope, as the case may be, in three different conditions, viz.: dry, wet and soaked. Diagram for untarred manilla and hemp rope: Here it will be noticed that the ratio of stretch to load is least for the dry rope, while those for the wet and soaked do not differ widely. The two curves are, however, quite different in shape. The soaked rope stretched less at first, but its curve soon crossed that of the wet rope by its stretch becoming greater. Then the stretch of the soaked specimen became less than the wet, as is shown by the two curves again crossing. At the upper limit of the load the two curves run nearly parallel. It would appear as if the great shrinkage in the soaked specimen at first resisted the load up to a certain point and then suddenly yielded somewhat more rapidly than the wet specimen and nearly finished stretching at the same time. This latter truth can be seen at once from the curve of the soaked rope by noticing how nearly vertical the curve is at its upper limit.

TABLE SHOWING COMPARATIVE STRENGTH OF ROPE BEFORE FIRST STRAND BREAKS, AND AFTER THE FIRST AND SECOND STRANDS BREAK.

Description of Rope.	1st Strand Break. Load.	2nd Strand Break. Load.	3rd Strand Break. Load.
Manilla	3,200	2,750	1,150
"	6,000	4,425	1,800
"	750	650	425
"	1,170	950	575
"	1,525	1,100	800
"	1,825	1,425	1,000
"	2,300	1,775	1,025
"	2,175	2,000	650
Tarred manilla	1,275	950	455
" hemp ratline	750	640	475
" "	1,120	890	380
" " boltrope	740	600	600
" " "	800	650	425
" manilla "	5,425	3,400	2,000
" " boltyarn	6,535	4,475	2,600

In the diagram for tarred rope there is not such a difference between the stretches in the three conditions. What seems surprising is that the ratio of stretch to load is least not for the rope when dry, as in the untarred specimen, but for the rope when wet; while it is the curves for the soaked and the dry specimens which intersect. Moreover, it is the curve for the soaked tarred specimen which most nearly resembles the curve for the wet specimen in the untarred rope. It is also to be noted that the ratio of stretch to load decreases at an increasing rate, which decreases as we reach maximum load.

DEDUCTIONS FROM THE TABULATED RESULTS.

The most noticeable fact is that a wet rope is stronger than the same specimen dry. This was no doubt owing to the fact that the rope was more pliable so that it adjusted itself in such a way that the stress was more uniformly distributed; and none of the fibers were strained to rupture almost, before others had any considerable stress; for we found that when any of the outside fibers on a bend, which of course are strained most severely, gave way, the rope was practically at its maximum load. The above was an important factor in determining the position of fracture. A larger proportion of the failures took place at the upper pin or thimble than in any other position. This was particularly so with the larger ropes, where the outside fibers were affected not only by the direct stress, but by this stress acting at a leverage of the diameter of the rope, minus the crushed depth, in the same manner as the outside fibers of a beam in a transverse test are affected by the skin stress and the depth of the beam We endeavored to place a sleeve on the pin, but the short distance between it and the head of the machine left barely room enough for the rope. This pin had no feather in it and turned round in its eyes, so that a greater portion of the stress developed in the specimen was transmitted down to the toggle end of the rope than would have been if the pin had had a feather to keep it from turning.

It will be noticed that a large number of breakages occurred at the upper thimble. We believe this to be due to the injury the rope may have sustained by the pin turning in its eyes, and not due to any defect in the method of fastening. The smaller number of breakages occurring at the bottom thimble, where the pin had a feather in it to keep it from turning, and where the fastening was similar to that at the top, would tend to confirm this.

Considering the bending moment referred to above it would be natural to conclude that a small rope would be less affected by it than a large one, and would be more likely to break at the centre. This was proved to be so by our tests. It may also be noted that the melting or soaking did not increase the strength of a tarred rope as much as that of an untarred. This would be expected, as tar allows motion of the fibers so that the stress is more uniformly distributed throughout the whole specimen. The increase in strength was greater in tarred manilla than in tarred hemp. Immersion always increased the strength of an untarred rope, but a continued immersion had no marked effect. It might be thought that the additional stretch of a wet or soaked specimen above that of a dry would be due entirely to the shrinkage. A comparison of results will show that this additional stretch is greater than the shrinkage.

CORROBORATION OF EXISTING FORMULÆ.

Most of the existing formulæ giving the strength of rope are very complicated and hard of application, but in "Jones and Laughlin's" hand book is the following formula: "To get strength of manilla rope, multiply the square of the circumference in inches by eight, and the result will be the number of hundred pounds required to break the rope." This agrees remarkably closely with the results of our tests; e.g., In the first rope of the tabulated results the formula giving the number of hundred pounds required to break the rope gives the following:

Load $= 2 \times 2 \times 8 = 32$; breaking load $= 3200$. Exactly what we obtained. Again, take No. 3:

Load $= 2.5 \times 2.5 \times 8 = 52$; breaking load $= 5200$, while we obtained 5150. Many others are equally near.

In submitting this thesis, we sincerely hope that the data tabulated, and the explanation given thereof, may be sufficiently lucid to all readers; and that the benefits obtainable therefrom may, in some degree, be commensurate with the labor entailed by its preparation.

For The Canadian Engineer.

WATER WORKS EXPROPRIATIONS IN CANADA.

BY WILLIS CHIPMAN, C.E.

The following is a list of the cities and towns in Canada that have from time to time acquired their waterworks systems by purchase or by arbitration from the private companies that owned and operated the works, and the price then paid by the municipality :—

Montreal, P.Q	1845		$250,000
St. John, N.B	1855		
Halifax, N. S.	1861		275,000
Toronto, Ont.	1873.	By arbitration	220,000
Kingston, Ont.	1887.	"	121,000
Niagara Falls, Ont.	1884.	"	17,000
Valleyfield, P.Q	1887.	By mutual agreement	
Brantford, Ont	1888.	" "	65,000
Owen Sound, Ont	1890	" "	55,000
*St. Cunegonde, P.Q.	1891.	" "	
*St. Henri, P.Q	1891.	" "	
Brockville, Ont	1892.	By arbitration	138,000
Vancouver, B.C	1894.	"	
Kincardine, Ont	1894.	By mutual agreement	40,000
Moncton, N.B	1894.	By arbitration	265,000
Chatham, Ont	1895.	By mutual agreement	145,000
Cornwall, Ont	1897.	By arbitration	86 500
Sherbrooke, P.Q	1897.	"	116,000
Barrie, Ont	1898.	"	78,000
Berlin, Ont	1898.	By mutual agreement	102,000

In Ontario an Act of Parliament was passed in 1882 empowering cities and towns to acquire waterworks or gas works by purchase or by arbitration. Six towns have taken proceedings under this statute since 1891, and have acquired their works, three by arbitration and three by mutual agreement.

In the Ontario Act, the word "value" is clearly defined as structural value at the time this value is being determined. Ten per cent. is, however, to be added to this valuation by the arbitrators.

The Ontario Act prescribes two methods of procedure :—

(a) The municipality may submit a blank by-law to the ratepayers before an offer has been made or a valuation prepared, which, if carried, empowers the council to proceed with the arbitration or to acquire by purchase.

(b) The municipality may proceed with the arbitration and take up the award, then submit a money by-law to the ratepayers for the purchase of the works.

In either case if the works are not taken over, the municipality shall pay all costs of the proceedings.

Berlin is the only place in Ontario that adopted the first method.

In 1898 New Brunswick passed an Act similar to the Ontario Act of 1882, but none of the other provinces have any such legislation.

In the Moncton Act, the word "compensation" was used as well as value, but in the Campbellton Act the word "compensation" did not appear, and "value" is not so clearly defined as in the Ontario Act.

In the following cities and towns the waterworks are now owned and operated by private companies :—

Belleville, Cobourg, Ingersoll, Iroquois, Lindsay, Napanee, Perth, Peterborough, Smith's Falls, Stratford, Trenton and Waterloo, in Ontario.

Aylmer, Berthier, Chicoutimi, Cote St. Antoine, Drummondville, Granby, Huntington, La Chute, Richmond, St. Lambert, and Saint Johns, in Quebec.

Lunenburg, N.S.; St. Stephens, N.B.; Winnipeg, Man.; Calgary, N.W.T.; Esquimault, B.C.; and Nanaimo, B.C.

THE SOULANGES CANAL.*

BY THOMAS MONRO, PAST PRESIDENT CAN. SOC. C.E.

At the close of 1888 the writer was transferred from the Welland Canal, and assigned the duty of determining the best location for a canal, having a navigable depth of fourteen feet, between Lakes St. Louis and St. Francis. After extensive surveys and examinations, he submitted a report, dated 15th June, 1889, addressed to the late John Page, M. Can. Soc. C.E., Chief Engineer of Canals, in which reasons were given why the new canal should be constructed on the north side of the St. Lawrence. Mr. Page died in 1890, and in June of that year a second report was addressed to the Secretary of the Department, confirming the views previously expressed. In that document the projected work was for the first time named the "Soulanges Canal." In a memorandum dated 25th January, 1891, prepared for the Right Hon. Sir John Macdonald, by Toussaint Trudeau, M. Can. Soc. C.E., Deputy-Minister and Chief Engineer of Canals, the scheme submitted by the writer was approved of in general terms. This view was subsequently confirmed by the Government, and, in August, 1891, a sum of $300,000 was voted by Parliament towards the construction of the Soulanges Canal, which was then estimated to cost $4,750,000.

Plans and specifications of the work were subsequently prepared; and in May, 1893, all the thirteen sections between Cascades Point and Coteau Landing were under contract. It is not intended to discuss in this paper the fitness or otherwise of the dimensions adopted for the Welland and St. Lawrence Canals. The writer's views on this important subject are fully set forth in his address on retiring from the office of president of this society on the 15th January, 1896. The object now proposed is to briefly describe the Soulanges Canal as it is, and to draw attention to the fact that in many essential features it differs in design from the other links of the St. Lawrence system.

It may be stated, at the outset, that more extended study of the question of the fluctuations of the St. Lawrence River led to the conclusion that it would be unsafe to accept previous records as a guide in fixing the heights of the mitre sills at each end of the canal. The lowest water at Valleyfield (1849-90) was in October, 1872; when it fell for part of one day to 10 ft. 8 ins. on the mitre sill of the guard lock at the head of the Beauharnois Canal. But the mean for that month was 11 ft. 13 inches. Practically, 11 feet would therefore represent extreme low water during the navigation season. Adopting this view, the sills of the guard lock at the head of the Soulanges Canal should have been placed 3½ feet lower to secure a fourteen feet draught. As a matter of fact, the sills of the Soulanges are 5 feet lower than those at Valleyfield; and it is due to this that, in November, 1895, when the lowest water occurred, of which there is any reliable record, there was a depth of 14.55 feet at the upper entrance, and 14.83 at the lower end of the Soulanges Canal. In the same month there was only 13 50 feet at the lower entrance of the Cornwall Canal, and 13.08 at the head of the Lachine Canal. Attention is drawn to these facts, because between the time when the estimate attached to the writer's report of June 18, 1890, was made, and the letting of the works, the bottom plane of the summit level (10½ miles long) and the foundations of the structures on it, were lowered about 1½ feet, largely increasing the quantities, and adding, at a fair valuation, about $500,000 to the estimated cost of con-

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These works were purchased by the municipalities in 1891, but soon afterwards they made arrangements with the Montreal Water and Power Company for a supply of water, and it is now reported that they are owned by this Company.

*A paper read before the Canadian Society of Civil Engineers.

struction, which, instead of $4,750,000, should be placed at $5,250,000.

It may also be stated that in previous canal surveys along the St. Lawrence, various datums were employed, making the results somewhat confusing, or only intelligible after a good deal of trouble. An attempt has been made to avoid this by referring the levels of the Soulanges Canal to mean tide at New York. To do this, lines were run from a bench mark established by the United States coast and Geodetic Survey at Rouse's Point, N.Y., to the head of the Beauharnois Canal. In this way the mean level of Lake St. Francis was found to be 154.80; and directly connected with the records at the Valleyfield lock since 1849. The United States Army Engineers have determined the mean height of Lake Ontario (1860-75) at 246.61 above the same datum, so that the difference between Lakes St. Francis and Ontario should be (to close the circuit) say 91.81 feet. Lines run under the writer's direction between Coteau Landing and Kingston confirmed these figures. But the previously accepted distribution of fall was found to be quite erroneous. The descent from Kingston to Prescott was supposed to be three or four feet. It is now approximated at about one-third of a foot, pending the completion of the precision levels begun some years ago under the able direction of Rene Steckel, M. Can. Soc. C.E., of the Public Works Department. This work has not yet been continued along the St. Lawrence above Lachine. It may be stated, however, that levels recently taken by the engineers of the United States Deep Waterways' Commission only differ 0.12 from the figures given above as representing the relative levels at Rouse's Point and Valleyfield—about $47\frac{1}{2}$ miles apart.

Attention was drawn to the lithographic profile of the St. Lawrence, prepared for the Canadian Deep Waterways' Commission of 1895, as explanatory of the foregoing remarks. This profile shows the position and length of the various canals between Kingston and Montreal. The fall in the river is about 220 feet. That overcome by locks is about 204 feet. It will be seen that Lake St. Francis is 33 miles long. It is merely an expansion of the river—a pool above the rapids between it and Lake St. Louis. The fall between these lakes is $82\frac{1}{2}$ feet at mean water. In this distance of about sixteen miles there are the Coteau, Cedars, Split Rock and Cascades Rapids. At some points on the river there is a depth of not more than six feet in the channel at extreme low water. It is to surmount these rapids that the Soulanges Canal has been constructed. Its position is shown on the small sketch map which accompanies this paper.

The canal is 14 miles long, and leaves the foot of Lake St. Francis at Macdonald's Point, just below the village of Coteau Landing. Thence it runs straight $1\frac{1}{2}$ miles, touching the margin of the river about a mile from the upper entrance. From the end of this tangent the line sweeps round to the north-east behind the village of Coteau du Lac for about three miles on a curve of 14,324. radius. It is then continued by a second tangent of some $8\frac{1}{2}$ miles long, passing about a mile inland from the Cedar's Village. At the termination of this, the line bends slightly to the north, and is led straight into the Ottawa River, about two miles from its junction with the St. Lawrence at Cascades Point. The canal is, for all practical purposes of navigation, a straight line throughout, and is two miles shorter than the route by the river. The fall of $82\frac{1}{2}$ feet is overcome by four locks. 70 feet of this is at the Cascades end, where the bluff forming the right bank of the Vaudreuil branch of the Ottawa gives an opportunity of locating three of these in the first mile; each having a rise of $23\frac{1}{3}$ feet. The original design was for five locks. This was subsequently made four, and, after extended examination, the writer, in January, 1894, proposed a further reduction to three. In this view he was sustained by Messrs. Shanley and Keefer, who were retained by the Government to advise in the matter. The height of these lifts constitutes a peculiar feature in the Soulanges Canal. There is an interval of over two miles between the third and fourth locks. The latter is about three miles from the lower entrance. Here the lift is variable. It is about $12\frac{1}{2}$ feet at mean water of Lake St. Francis—but at extreme high periods it would (if this water were permitted to enter the canal) be about 15 feet. At the upper entrance there is a guard lock by which the surface level of the summit can be regulated without interruption or danger to navigation. At periods of high water, this will be used as a lift lock, but, at ordinary stages of the lake, its surface level will be that of the canal. It is needless to point out to this audience the necessity of this arrangement. Canal engineers of experience will admit that such a safeguard is indispensable. About 1,000 feet above lock No. 4 there are a pair of guard gates placed for safety to the lower locks in case of accident.

It will be observed that the surface of the blue clay along the summit reach gradually rises towards the west and culminates at the crossing of the St. Emmanuel Road, where it is almost level with top bank, being only covered with a thin layer of sandy soil. Wherever this clay was cut into by the prism, there was danger of slides, roughly in proportion to the depth of the cutting. This danger was greater on the north side, which intercepted the natural drainage towards the river, so that in time the slope became so saturated as to break loose and slip into the canal. In other words, by the excavation of a deep trench of such dimensions, a similar condition of things was set up as that existing along the bank of the St. Lawrence between Coteau and Cascades, where, from time immemorial, *deboulements* have occurred, causing in many places a wearing away, which in some cases is measured by hundreds of feet. One of these slides took place on the 25th October, 1897; when, without any previous perceptible warning, the north bank of the canal, for over a quarter of a mile in length, slid into the prism, taking with it the abutment of the St. Emmanuel bridge, which was thrown bodily forward about fifty feet into the centre of the canal. This occurrence is considered to be of so much interest as to warrant its being made the subject of a separate paper. To discuss it in detail at present would take up too much time. Slides have also occurred more or less for a mile or so to the west of the St. Emmanuel Road, but a plan of repairs has been adopted which will enable the north slope to be satisfactorily restored in time for the opening of navigation through the canal. Towards the crossing of the river Delisle, the surface of the blue clay lowers rapidly. At the river itself rock of the "calciferous" is encountered, and this alternates with the clays and sands of the drift formation for some two miles to the west. At the upper entrance the guard lock and surrounding structures are all founded upon solid rock. There are about $6\frac{3}{4}$ million cubic yards of clay of all sorts, and 300,000 cubic yards of rock of various kinds in the excavations for the canal.

The level of the bottom of the summit reach at the foot of the guard lock is 137.00 above datum. Ordinary surface of Lake St. Francis may be taken at 155.50, at which time there will be $18\frac{1}{2}$ feet of water in the canal, equal to a cross sectional area of 2,534 square feet. Propellers of the type now being built on the upper lakes to navigate these canals will have a submerged midships section of say 42 × 14 = 588 square feet, or less than one-fourth of that of the water area at mean level. This will permit of a fairly high speed through the summit reach, which it will be observed forms 75 per cent. of the whole length of the canal. The bottom of this reach has an inclination of 0.10 per mile. Top bank is level and 161.0 above datum. The cross section of the canal has, as before stated, been kept as nearly as possible uniform throughout. This will avoid the creation of cross currents, and facilitate the rapid navigation of the canal. The relation of the area of the vessel to that of the canal is a matter of much importance. Full depth under the keel is of great value, both for speed and safety. The whole question of the gain in time in relation to the cost of construction affords ample scope for further investigation. It does not appear as if a slight increase in speed where the canals are short in comparison with the length of natural navigation would warrant a largely increased outlay even where ample means are at hand. As to locks, it is believed that, as has been stated, "The single individual lock is better than the fleet lock, and can be operated more quickly—and the maximum facilities may be provided by duplicate locks. The lift of locks should be made as great as possible where conditions permit, as time is consumed by the number of locks rather than by the lift."

To return to a description of the locks. It was the writer's intention that these should be constructed wholly of concrete up to the level of the surface of the lower reach. In this particular the design was almost wholly frustrated, lock No. 4 only having been built on this plan. The nature of the foundation of all the locks having been previously indicated, it will perhaps be as well to describe the general features of lock No. 2, and thus avoid tedious repetition. It will be observed that the lock is filled and emptied through culverts in the side walls, from which cast-iron pipes 30 inches in diameter—ten on each side—lead into the bottom of the chamber. These pipes have about 40 per cent. greater discharging capacity than the culverts themselves. The lock will be filled in about five or six minutes, and this will be effected without subjecting the vessel to much surging or strain. At the head and foot of each culvert there is placed in a shaft (8 x 4 feet) operated from the coping a 6 x 6 feet sluice of the "Stoney" pattern. These are for the first time introduced into a Canadian canal. Their operation is, as will be seen by the drawings, exceedingly simple. They are in extensive use in Europe, and have given the best satisfaction in controlling large bodies of water. They are used for that purpose on the Manchester ship canal. It may here be stated that the details for these gates on the Soulanges Canal have been worked out and modified by Geo. H. Duggan, M. Can. Soc. C.E. This has been skilfully done; and it is believed that their operation throughout will prove quite satisfactory. The method of emptying and filling locks through tunnels in the side walls is considered to be entirely the best, and manifestly better than any system of filling from below the floor. The main object in adopting this plan was, however, to avoid that in vogue in the Welland Canal, where the filling and emptying is done through valves in the gates. This is objectionable from every point of view. It weakens the gates just where most strength is required, and weighs them down with cumbrous valve gear. Besides, it introduces the water for filling so as to strike the stem of the vessel heavily, creating unnecessary disturbance in the chamber and a tendency to surge it on the upper gates. All this is now well known to practical men, and need not be dilated upon here. It will be observed that each lift lock is provided with a heavy breast wall at its upper end, corresponding in height to that of the lift. These walls have been re-introduced for the purpose of removing the cause of about nine-tenths of the accidents which have occurred on the enlarged canals; namely, vessels carrying away the upper gates of the locks by striking them whilst entering from the lower reach. It is difficult to understand why all the four gates of each lock on the Welland and other canals were made the same height—but there is no doubt the plan is defective. If a vessel goes ahead too far in a Soulanges canal lift lock, she will strike against the breast wall, and damage herself instead of the gates. The filling and emptying of the lock having, it is believed, been secured in a reasonable time in the way above described, it may now be stated that an attempt has been made to simplify the manner of working the gates by the use of struts in the manner shown in the accompanying drawings. An inspection of these will render further description unnecessary. It may, however, be noted here that the writer made a series of experiments in 1894 at Lock No. 9 of the Beauharnois Canal, which convinced him that this method would prove entirely practicable. Since then machinery of a similar kind, but on a greatly larger scale, has been and is now in operation on the North Sea Canal

The distribution of lockage as above described is supplemented by a series of weirs for the passage of the necessary supply. That at the head of the canal has four openings 9 x 10 feet, furnished with gates of the "Stoney" pattern. The tops of these gates will be submerged when hoisted. This structure is connected with a raceway of large dimensions formed to the south of and parallel to the guard lock. This channel is about 650 feet long, and is pitched on both sides. It passes into the canal through a series of masonry arches, and will amply fulfil the intended purpose without creating objectionable currents. About five miles from the upper entrance, at the crossing of the à la Graisse River, a large weir has been constructed having six arched openings 6 x 6 feet. It will regulate the summit level of the canal, which can be either lowered or entirely emptied at this point. The channel from the weir connects directly with the river à la Graisse a short distance from its junction with the St. Lawrence. In connection with this weir, a power-house is being erected which will be alluded to further on. The supply is passed by the guard gates above lock No. 4 through two 20 x 22 feet Stoney sluices; and at locks 4, 3, 2 and 1, the regulating weirs consist of twin culverts through the dividing embankments between the various reaches, having submerged gates controlled from top bank level through shafts of concrete and masonry. It will be observed that the water for supply is not in any case passed over breast walls, the writer's experience being that such an arrangement is objectionable in this climate.

There are seven road bridges and one railway bridge across the canal. The latter traverses the lower wings of the guard lock, and carries the Canada Atlantic Railway. It swings over the lock and raceway, and is about 180 feet long. The superstructure of this bridge was manufactured and erected by the Dominion Bridge Company, of Lachine, Que. At the head of this lock there is another swing to pass the main road between Coteau Landing and Cascades Point. A similar structure will be erected at lock 3 in connection with the Quinze Chiens Road. The superstructure of these two small bridges is from the shops of the Weddell Company, at Trenton, Ont. The remaining five road bridges cross the full prism of the canal, and have been designed to permit a full and free flow for the water, and so as not to impede rapid navigation. This is effected by building the pivot pier in a line with the toe of the south slope, between which and the foot of the north slope there is an opening of 100 feet. The bridges are 242 feet long, and the south half swings partly over the land and partly over a channel formed in rear of the pivot pier to give additional water section. It is believed that this is a considerable improvement on the old method of placing the pivot in the middle of the canal with a narrow channel on each side of it where vessels have to slow up, and often find it difficult to get safely past. The piers, abutments, etc., of these bridges are of concrete coped with cut stone. The superstructure was manufactured and erected by the Dominion Bridge Company in a quite satisfactory manner.

To pass the drainage of the country lying to the north, across the line of the canal, has necessitated a very large outlay. The first stream met with in descending is the river Delisle. This has its sources some sixty miles inland. Its catchment basin has an area of about 180 square miles, and during spring floods the flow is sometimes over 200,000 cubic feet per minute. The river is passed under the canal through four lines of cast-iron tubes 10 feet in diameter, laid in a trench fifty feet wide, excavated in the rock to the depth required. The tops of these tubes are two feet below canal bottom. At each end there are masonry wells, and at the north end the macadam road is carried over by arches of masonry and concrete. This structure has been found to answer the required purposes satisfactorily. At no time has there been, so far, a greater head than from 18 inches to two feet on it, whilst the position is such that no just claims for backwater can arise. In connection with this culvert there has been excavated a channel of diversion of considerable length and dimensions, which secured a good foundation for the structure and diminished the interruption from water which would have been inevitable had it been placed in the old bed of the river. It is believed that this plan should be followed where at al practicable. The next stream is called the Rouge River. Its flow during floods is about half that of the Delisle, and it is carried under the canal by two lines of tubes of the same diameter as those previously mentioned. The excavation for the foundation of this structure was carried down to boulder clay through a stratum of soft blue material, which gave a good deal of trouble through sliding during the progress of the work. A diversion channel has been formed here also, the sides of which are pitched with masonry laid in cement. At the à la Graisse River the water is carried by a single line of tubes 10 feet in diameter. The foundations of this structure are on piles driven some 25 to 30 feet to hard material. There are also two pipe culverts of small dimensions towards the lower end of the canal which do not merit particular description.

Now as to the dimensions of the canal itself. Ordinary prism is throughout about 100 feet wide at bottom with side slopes of 2 to 1. The banks or cuts are first formed to these and then a notch is cut to receive the stone protection lining. This reaches from four feet below to four feet above mean level in the summit. It is about 3 feet wide at the base, tapering up to about one foot on top, where it is finished by a rough coping. Between this coping (158.0) and the top of the bank (161.0) the surface of the slope is sodded, the sodding being returned about five feet on the level. On the north side of the canal a macadam road, 16 feet in width, will be formed throughout its entire length, the centre of which is 33 feet from the edge of the cut or bank on that side. This road was designed, not only for the sevice of the canal, but also to provide a means of intercommunication between the various farms cut across by the canal and the sideroads where bridges are built; and so, if possible, reduce damages—a result which has not, however, been realized, as the sums paid for right of way are very much greater than was anticipated. The total quantity of land taken is about 950 acres, ample width having been secured throughout. Wherever practicable, material arising from the excavation has been used to widen out the embankments to give additional safety to the north side of the canal, where in-filling is fifty feet wide on top. On the south side it is generally thirty feet at least. The large amount of surplus material was spoiled either on land adjacent to the canal taken for that purpose, or wasted into the St. Lawrence river at several points. At the Cascades' end the excavation is of rock of the Potsdam formation, which affords a solid foundation for locks Nos. 1, 2 and 3. The upper extension walls of the latter lock are, however, of piles and concrete. The reach between locks Nos. 3 and 4 is in clay, upon which the piers and abutments of the St. Antoine Road bridge are founded.

At lock No. 4 solid material is from 30 to 35 feet below the floor line. The lock walls are therefore placed upon a foundation of piles and concrete. They are 36½ feet high, and, from careful levels taken before and after building, have not perceptibly subsided. The structures immediately to the west of lock No. 4, viz., guard gates, sluice abutments, retaining walls, etc., are all founded on the clay, which affords a sufficiently solid bearing. The road bridges at St. Fereol and St. Dominique are also built on similar material. The gates are constructed on what is called the "solid" plan, which consists of a number of superimposed timbers shaped to the required horizontal pattern and fastened together. The method is simple and in this case the strength is superabundant. One leaf of the lower gates of the high lift locks at the Cascades' end of the canal weighs over 90 tons in the air. The drawings were made by J. B. Spence, M. Can. Soc. C.E., and the gates have been constructed in a thoroughly workmanlike manner by the firm of J. & R. Miller, of Ingersoll, Ont., who have had very extensive experience in connection with the Welland and St. Lawrence canals. The timber used is principally Douglas fir, which was hauled across the continent for that purpose. A number of spare gates are on hand in case of accident.

It is proposed to work a lock from one point on the south side, and about 20 feet back from the coping, where a switch cabin will be placed. This will be connected with the motors actuating the sluices and operating bars previously described. Suppose a vessel to enter the lock from the lower level. When her stem is up to the breast wall she signals, and the lower gates are closed. The machinery will effect this in a perfect manner. The gates will shut precisely and synchronously, and avoid any trouble from over-lapping, which often occurs now. This should be done in one minute. The lower sluices are then dropped and the upper ones hoisted, the lock being filled as indicated. When the water has risen to the full height, the upper gates are opened and the vessel passes out. The lockages should be easily made in from 12 to 15 minutes. But the saving of time at a lock, although of much importance, has been unduly magnified. The capacity of the canal at four lockages per hour on the basis of one-third westbound freight would be about 20 millions of tons in an ordinary season. Of course, this estimate is merely theoretical. But even if one-half of it is realized, it will require a good many ports like Montreal to handle such tonnage economically.

In the construction of the Welland canal locks, nearly every mitre sill on the line was forced up, causing great delay to navigation, annoyance, and much expense. The plan of mitre sill and bottom designed for the Soulanges canal will, it is believed, fully obviate these difficulties. It will not be possible under any imaginable circumstances to disarrange sills held down as shown on plan of lock No. 2 ; and which is a type of all the rest. It will also be seen that the mitre sills themselves are the only pieces of timber in or connected with the lock bottom, and these can easily be renewed when this becomes necessary. The extension walls above and below the locks and in immediate connection with their masonry should not be built on a twisting batter. Where these walls cease to be self-sustaining and become slope walls, they are sure to crack—and besides the bases of those of the lower ends of the locks are liable to be washed out by the strong currents created when they are emptied, and have a tendency to slide into the canal All the walls connected with the upper and lower entrances to the locks of the Soulanges Canal stand upon their own bottoms, and are therefore not liable to failure in the way alluded to. The macadam road which runs along the north side of the canal is carried past the locks by a series of ramps, the inclination of which does not exceed 1 in 8. To enable foot passengers to surmount the rise between the different levels, a flight of steps is provided on each side of the lower ends of all the locks.

Concrete has been introduced into the construction of these locks to an extent greater than heretofore in Canada. Since the plans for them were made, the use of this material has rapidly spread. But a few years ago experienced hydraulic engineers looked upon construction with suspicion, at least in this climate. This is not to be wondered at, because the cement (which is the life of concrete) supplied was of very inferior quality and manufacture. Now, however, excellent Portland is obtained at moderate rates. On the Soulanges canal the writer specified that cement of a certain quality should be supplied by the Government to the several contractors—and should not be purchased by them at all. The benefits of such a course are obvious. There is no inducement to supply an inferior article or to stint its use ; both of which may happen with the ordinary type of canal contractor. It is better to remove the temptation than to depend upon the virtue of the individual. The specifications for the preparation of concrete do not offer any feature out of the common. Some 70,000 briquettes have been made for testing purposes in a quantity of about 200,000 barrels. Good clean sand and properly broken stone have been insisted upon ; and so it is believed that this work is excellent throughout. Mixing has been done both by hand and machine, but in either case the product when carefully laid and rammed makes an unexceptionable hydraulic wall, whilst its cost per cubic yard is less than half that of masonry. Of course this varies with circumstances, but on the Soulanges canal its use is clearly suggested by the fact that in the excavation for the prism about 300,000 cubic yards of rock had to be taken out, which is excellent for concrete, but unfit for masonry. This supplied the 150,000 cubic yards required for concrete—also about 120,000 cubic yards for stone protection, lining together with over 50,000 cubic yards for macadam, repairs, etc., leaving a large surplus to be thrown to spoil. It will be seen on reference to the plan of road bridges that these structures are almost entirely of concrete, the copings only being of cut stone. This remark will also apply to the retaining walls, regulating weirs, etc. A large amount of concrete was also used in connection with the culverts under the canal, and in other positions too numerous to mention.

Time will not permit of more than a passing reference to the style of supply weir or regulating culverts designed for the canal. The plans will show details of construction. They can be made to control the levels automatically if so required. It will be seen that the weir at Lock No. 4 is connected with its south wall, and differs in construction from those at the lower locks. It is believed that the drawings and photographs will show with sufficient clearness the main features of the culverts under the canal to pass the Rivers Delisle, Rouge and à la Graisse. The casting of the ten foot tubes was done by H. Ives & Co., Montreal.

The site chosen for a power house to generate electricity for the operating of the locks, bridges, etc., and the lighting of the canal throughout, has many advantages, and will perhaps merit a brief description, which must close this paper. At this place the River à la Graisse crosses under the canal and joins the St. Lawrence about 400 feet to the south of it. The surface of the canal is as before stated at ordinary stage about 155.50 above datum. At such time the à la Graisse is about 135.00 or 20.5 feet lower. It is obvious that by drawing a sufficient volume from the summit reach and passing it through wheels, power can be readily obtained here ; and from this site a free discharge can be had into a wide tail race connecting directly with the St. Lawrence on Government property where no claims for damages can arise. Of course the above height of 20.5 feet represents the fall on the River St. Lawrence between Lake St. Francis and the mouth of the à la Graisse. The amount of electrical power required to operate the locks, bridges and other structures, and to light the canal satisfactorily throughout its entire length of fourteen miles was carefully determined by the officers of the Royal Electric Company, who also worked out the details of the distribution and application of this power. They also provided designs and drawings for the power house proper, and the switch cabins at the various locks, together with the necessary specifications. The hydraulic development was entrusted to A. M. Rice, of Dayton, O., a gentleman of acknowledged skill and experience in such matters. He prepared plans showing the number and position of the wheels, tail races, etc. These have been partly carried out ; and work will be resumed in the spring. The power house is connected with a regulating weir previously referred to, and which is intended to control the summit level of the canal without discharging a great volume of water through the Cascades locks. The works for electrical power plant have been recently let, and the whole system will be in operation next season. The canal will be efficiently lighted throughout, and, considering its position in the St. Lawrence system, this will be of great importance in securing safe navigation through it by night. The entrances at each end of the canal are wide, of full depth, and sufficiently commodious. It will be observed that there are concrete walls heavily coped with cut stone on the top of the cribs forming a permanent face work instead of the timber generally used in such positions.

There are a number of other matters of interest to canal engineers which cannot even be touched upon in this sketch. It will, however, be seen that an attempt has been made to provide an unobstructed channel of full dimensions for a fourteen foot navigation at lowest water, with a much less number of locks than has hitherto been deemed advisable to overcome a similar fall on the other canals of the St. Lawrence system. In construction materials of a practically imperishable kind have been almost wholly used, and this fact, taken in conjunction with the improved methods of operating the locks and bridges, will, it is believed, largely decrease the annual expenditure for maintenance and operation.

The writer sincerely hopes that the beneficial results which must follow from the completion of the St. Lawrence Canals to dimensions capable of passing vessels of 2,000 tons will be realized to the fullest extent; and that the immense expenditure so pluckily incurred by Canada with her comparatively small population and limited resources may at last draw to our national route the current of European trade for which we have waited so long. The writer may be permitted to state, in conclusion, that, in his humble opinion, if such a large volume of traffic as may be reasonably expected on the completion of the St. Lawrence canals, has to be economically and quickly handled at Montreal—a very different condition of things to that existing there must be at once established and maintained. If not, the expected benefits to Canada will be largely neutralized, or the point of trans-shipment for grain in bulk, and whole cargoes, will be transferred to Quebec.

The thanks of the writer are due to John L. Allison, M. Can. Soc. C. E., by whom he was materially aided in the preparation of the general designs for the canal and its structures. He also desires to acknowledge the zeal and intelligence of C. R. Coutlée and A. J. Grant, MM. Can. Soc. C. E , to whom, together with a staff of juniors, inspectors, etc., the superintendence of the principal works was entrusted.

At the conclusion of the paper the magic lantern was brought into requisition, under the direction of Mr. Redpath, and Mr. Monro made an interesting running commentary on the pictures as they were thrown on the screen. His explanations were listened to with the closest attention, and a hearty vote of thanks was passed, on motion of Stuart Howard, of Montreal, seconded by Geo. A. Mountain, of Ottawa.

The chairman congratulated both the society and Mr. Monro on this valuable paper. This was the first annual meeting for which papers had been specially prepared, and the maintenance of this feature would add greatly to the interest of the meetings, and would increase the attendance.

Mr. Keating would be glad to know if Mr. Monro had noted any effect on the concrete from the action of the sun or frost. He had noticed that in Halifax, where there were sudden and extreme changes in temperature from rain and its accompanying temperature to below zero, the east side of the graving dock on which the sun had most power was badly scaled from the alternate action of the heat and frost —was the effect the same at the Soulanges Canal ?

Mr. Monro said that after three or four years' exposure there was no degradation, either from change of temperature or other cause. In reply to several questions he said that nearly all the cement used in the canal was foreign Portland of the best brands. There were five or six of these all about equally good, namely "Condor," "Jorson," "Alsen," "Dyckerhoff," "Hemmoor," &c. There had also been used some Canadian Portland of the "Star" brand, which was found to be an excellent article. The proportions used were 1 of cement, 3 of sand and 6 of stone, broken into cubes of about 2 inches. It was true that in the land slide of October, '97, the wall of concrete was thrown down, but it fell as a monolith, and in its whole extent of 80 ft. long by 26 ft. high, there was not a crack caused by the fall, and one could not put a penknife between the coping stone and the concrete. The question remains to be decided how far we can use concrete to advantage in canal work. He was convinced by an examination of the Manchester Ship Canal in 1891, and of the breakwater at Buffalo in 1892, of the effciency of concrete work for canals. When he saw the Buffalo breakwater it had been built for four or five years, and had been covered with enormous piles of ice and exposed to violent gales without any signs of weakness. He did not think the concrete at the Soulanges Canal cost on the average more than $5 or $6 per yard. While the proportions were as already mentioned, they sometimes used one of cement, five of sand and ten of broken stone, according to the nature of the work. The facing mortar was incorporated with the body of the concrete and mingled with it, the two being made at the same time. The concrete was made in thick layers, but was often dumped down in large lumps, and he did not believe in putting it down in thin regular layers.

Mr. Marceau commended the plan here adopted of returning to the breast-wall as a guard against accidents to vessels. The lack of a breast-wall such as this was the cause of nine-tenths of the accidents in recent years on our canals. As the breast-walls were placed in this canal, a boat could not touch the gates to break them.

Mr. Monro said the mitre sills were laid in masonry checks so that the timbers could be removed without disturbing anything. It often happened with the old locks that stones would get in between the gates, causing trouble. To avoid this he had iron plates six inches wide by $\frac{7}{8}$ inch thick put on the upper face of the sill and under the gate, so that when a stone got between the gate and the mitre, it was crushed without doing any damage to the gate. In reply to further questions Mr. Monro said the concrete was deposited both in the water and out of it. In the former case it was boxed in, and was frequently deposited a foot or more under water, but it set as well in one case as the other. The "slope protection" to prevent the wash caused by passing vessels, was here laid with smaller stones than in former works, as the small stones were less disturbed by the waves. These stones were laid down to a thickness of 3 feet at the bottom, shallowing to a foot thick at the top, the top being about 4 feet above the water level, and the bottom about 4 feet below the water level.

Prof. Bovey, on the conclusion of the paper, asked Mr. Rogers as to the crack that had developed in one of the locks of the Trent Canal. What was the length of this body of concrete, and was one section of it allowed to set before the next was added ?

Mr. Rogers said it was laid at regular intervals in horizontal layers, and the length of the wall was 40 ft.

Prof. Bovey did not see why a piece of work 400 ft. long should crack any more than one 40 ft. long. He did not think that contraction or expansion would account for it. He was glad to know that in this work and the Soulanges Canal, the Canadian brands of cement had given such a good account of themselves. There was now every prospect that Canadian makers would produce a quality of cement that could not be beaten by the product of any country in the world. Of special interest was the hydraulic lift lock referred to in Mr. Rogers' paper, and the whole work would not only prove a credit to the country but to the engineers in charge of it. He hoped that it would also prove to be fully as great a commercial benefit to Canada as Mr. Rogers hoped.

In reply to Mr. Leprohon, Mr. Rogers said the cement was tested to 250 lbs., but they had not called for any specific mixture of sand. In reply to Mr. Rust he said the cost was about $5.25 per cub. yd. Replying to Mr. Skaife he said the Canadian brands of cement used were the "Star" brand and the "Samson" brand, and they had given the best satisfaction. To a question by Mr. Kennedy he said the width of the crack referred to was $\frac{1}{64}$ to $\frac{1}{32}$ of an inch, this part being built on rock foundation. In cold weather it opened very slightly.

Mr. Butler (Napanee), observed with regard to the last point, that the co-efficient of expansion of concrete was about the same as that of cast iron. Now, when a large mass of concrete was built up it adheres to the bottom and becomes attached to the back, which causes friction through expansion and contraction. These forces of expansion and contraction have to be restricted by the inherent strength of the mass of concrete. It will expand in the least restrained direction, and if the wall was weaker in one spot than another it would there give way. It was not practicable to get that perfect homogeneity that would insure a long wall from cracking. If you walk along the concrete sea walls you will see these cracks occurring wherever they are not provided for. It was therefore better to build in blocks of reasonably limited size.

Prof. Bovey observed as to testing, that it was easy to lay too much stress on a test. The difficulty is that there is no uniformity of procedure among the testers themselves; so that no two testers will give the same results from the same materials. In all tests the neat test and the sand test should be carried out. Above all, tests should be made with a standard quality of sand, and under a definite pressure which should be the same in all cases. Even University tests were disputed; and to show how small a circumstance may affect the result, he cited a case where a test was returned from McGill quite different to what the applicant had looked for, when it was compared with another test. But he pointed out that in carrying out one of these tests a little of the cement had settled on the meshes of the sieve and had become hardened, thus materially altering the result when the same sieve was used again. This showed how important it was that all the conditions should be precisely the same in all tests. If we can eliminate these differences we shall be able to show results with Canadian cements quite as good as any that can be shown across the water. He was pleased to move a vote of thanks to Mr. Rogers for his interesting paper. This was seconded by Robt. Surtees, of Ottawa, and carried.

METAL IMPORTS FROM GREAT BRITAIN.

Following are the sterling values of the imports from Great Britain of interest to the metal trades during January, 1898 and 1899:

	January. 1898.	January, 1899.
Hardware	1,609	1,538
Cutlery	3,329	4 765
Pig iron	504	361
Bar, etc.	200	445
Railroad	50	..
Hoops, sheets, etc.	814	125
Galvanized sheets	1,976	488
Tin plates	11,617	5,685
Cast, wrought, etc., iron	1,573	997
Old (for remanufacture)	..	..
Steel	4,521	3,770
Lead	924	889
Tin, unwrought	301	2,515
Alkali	1,501	1,545
Cement	485	213

SILICA PORTLAND CEMENT.*

BY M. J. BUTLER, M. CAN. SOC. C. E., ETC.

Consulting Engineer to the Rathbun Co., Ltd., Deseronto, Ont.

Silica Portland cement, as manufactured in Canada, is a mixture in equal parts by weight of a high-grade Portland cement and clean, dry Silica sand, ground together to an extreme degree of fineness, in mills specially designed for the purpose.

The Portland Cement used has the chemical composition and properties shown below:

The resulting Silica Portland Cement has the chemical composition and properties shown below:

	PORTLAND CEMENT.		SILICA PORTLAND CEMENT.	
Chemical Analysis	Lime	62.0	Lime	31.0
	Silica	22.0	Silica	61.0
	Alumina and iron	12.0	Alumina and iron	6.0
	Magnesia, sulphuric acid, etc	4.0	Magnesia, sulphuric acid, etc	2.0
Fineness.	Residue on No. 100 Sieve—		Residue on No. 100 Sieve—	
	10,000 holes to the square inch	8%	10,000 holes to the square inch	Nil
	Residue on No. 200 Sieve—		Residue on No. 200 Sieve—	
	40,000 holes to the square inch	35%	40,000 holes to the square inch	7%
Tensile Strength, lbs. Per sq.-in.	Neat cement mortar, lbs. per square inch:		Neat cement mortar, lbs. per square inch:	
	One day in air, six in water	500	One day in air, six in water	350
	One day in air, twenty-seven in water	600	One day in air, twenty-seven in water	450
	Three part standard sand		To one part cement.	
	One day in air, twenty-seven in water	200	One day in air, twenty-seven in water	200
Soundness—Absence of Free lime Unhydrated.	Very great care is taken to ensure a Portland cement that is absolutely sound, i.e., free from unhydrated calcium oxide.		As silica in itself is wholly inert, the resulting mixture of sound Portland and pure silica must likewise yield a sound cement; the small percentage of lime is a further assurance against the possibility of a blowey cement.	

Portland cement and clean, dry sand are weighed into the tube mill in equal quantities by a continuous uniform feed adjusting device, and in order to make clear the process of grinding it will be necessary to give a brief description of the tube mill. It consists of a horizontal steel cylinder, 18 feet in length by four feet in diameter, lined with specially hard cast-iron plates, which slowly wear away. The mill revolves at the rate of 27 revolutions per minute, and is filled half full with flint pebbles. The sand assists the pebbles in the grinding action, being itself, at the same time, reduced to a very fine state. The cement is reduced to an impalpable powder and is thoroughly intermixed with the ground sand, in fact, each minute particle of silica is enveloped with a flour of cement. Silica Portland has all the good qualities usually found in the best Portland cement, and the question naturally arises: Why is it? How is it possible to add 50% of inert material to a barrel of cement, and by the mere act of grinding them together to secure practically the same cementitious value as before the addition? An effort will be made to explain the seeming anomaly, as compared with the fineness of the molecule, the finest ground particle is coarse, yet the more nearly we approach the ultimate molecule, the more nearly we render it possible for the elements present in the cement to unite together and crystallize into the silicates which form cement.

A barrel of Portland cement when ground to the finest degree commercially, practically has quite 50% of the material too coarse to admit of crystallization, the underground particles are for all practical purposes inert matter, sand if you please, the active cementing material is the impalpable flour. Now, in the case of Silica Portland, the whole of the cement is ground to this impalpable flour-like condition, and therefore in a position to do work; the silica is reduced to a minute degree of fineness also, but not to the same extent as the cement, each speck or particle of silica is enveloped, wrapped up, in a layer of flour-like cement and offers a clean, sharp surface for the cement to adhere to. All very finely ground cements show strong adhesive properties, hence we see the useful function the silica performs; it takes the place of primarily, the unground clinker, and secondarily, is an excellent filling material, wholly inert under the usual conditions to which cement mortar is exposed, and in itself is stronger than the unground particle of clinker it has displaced. Owing to the exceeding fine conditions of the material, when tested neat it does not give as high a tensile strength as the more coarsely ground Portland cement, yet when made up into mortar, with three parts of sand, it actually equals in strength a like proportioned mixture of the Portland.

It is a peculiar fact that mortars made from very finely ground cement do not show quite as strong a resistance to abrasion, although they excel in adhesive properties. Hence the concrete for pavements and such like work preferably should be made of Silica Portland, and the top wearing surface of the coarser Portland cement. There are certain uses which silica cements are peculiarly well adapted to. Speaking generally, all cases where the low percentage of lime is an important factor: Notably in lining digesters for the manufacture of sulphite wood pulp it has been found of the very highest value, in sewers where free ammonia or acids are likely to attack the mortar and in all such cases. In pointing fine stone work, the color and permanent properties are peculiarly valuable.

Silica Portland Cement has already largely entered the market and proven itself a valuable cement. The following partial list will show to what extent and the nature of the work where it has stood the test of experience: The Laurentide Pulp Co., Grand Mere, Quebec, 21,000 barrels in concrete masonry, floors, brick work, etc; Montreal Street Railway Company, in concrete and floors, etc., 2,500 barrels; Canada Paper Company, Windsor Mills, N.S., 1,000 barrels; W. W. Ogilvie, Montreal, 1,000 barrels; Holland Emery Lumber Co., Byng Inlet, Ont., for saw foundations, 750 barrels; Riordan Paper Mills, 1,000 barrels; Dalhousie street station, C.P.R., Montreal, masonry, floors, etc., 2,200 barrels; Longue Pointe Asylum, Montreal, 880 barrels; Ottawa, Ont., pavements, 3,500 barrels; Cornwall, Ont., pavements, 600 barrels; Waterloo, Ont., pavements, 900 barrels. It has also been used in sidewalks and pavements in Ontario towns to the extent of some 10,000 barrels. Among other users are the Grand Trunk and Canadian Pacific, Central Ontario and Bay of Quinte railways, Public Works Department, Ottawa; in all over 75,000 bbls. of Silica Portland Cement have been used in Canada, although the manufacture was not undertaken until the season of 1897. Arrangements are being made to double the output for the ensuing season. It has been said by rivals that this cement gives facilities for adulteration not equalled by other cements, and objections have been made by "smart Alecs" that they had plenty of sand without buying it in the form of cement. Of course all such objections are met at the outset with every new material. When Portland cement was first produced it had to undergo an equally hostile criticism, and this naturally brings us to consider the testing of cement, a subject on which there has been a great deal written. The following scheme conforms to the best thought and experience in the engineering world:

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*Paper read before the Engineering Society of the School of Practical Science, Toronto.

TESTING.

Hot Bath Test.--Faja's apparatus is so simple and well-known that it is unnecessary to describe it, but let me draw attention to a point sometimes overlooked. The sample when trowelled on the glass, should be well worked up, the air and excess of moisture worked out, and the sample be covered with a wet cloth, otherwise drying cracks may show up across the thickest part of the slab. This drying crack is sometimes mistaken for an expansion crack and the cement condemned. Too much importance is sometimes attached to the fact that the sample leaves the glass. If, as is usual, smooth glass is used, the slightest jar will loosen the slab. If it preserves its shape and does not curl up or show fine hair cracks at the edges, there is no danger to be apprehended from free lime, in fact from the low percentage of lime present a blowey Silica Portland Cement is almost an impossibility.

Specific Gravity, Weight per Bushel, or other Density Test. —Silica Portland Cement weighs a little less than Portland cement. It is so very finely ground that for equal measures, owing to the greater bulkiness, it must weigh less. In any case, the old test of weight per bushel should be abandoned as being unscientific and misleading; offering as it does, a premium on coarse grinding. The specific gravity test is a delicate laboratory test and is one requiring a high degree of care and skill, as usually conducted by volumetric displacement, confined air, minute error in reading, a slight change in the temperature of the liquid used, or irregularity in measuring apparatus or weighing, may give widely varying results. The object of the test is to determine the density of the cement, i.e., the sufficiency of the burning; in other words the soundness, hence the hot bath test practically suffices and is much more easily made.

Tensile Strength.—Neat tests, as usually made, show Silica Portland to be slightly weaker than Portland cement, this is probably due to the fine grinding. Mortar tests, however, are the best of all, and show the real working qualities of any cement, and it is as a mortar maker that Silica Portland proves its good qualities.

Having satisfactorily determined the safe qualities of the cement, having shown it to be sound, strong, both in neat and mortar tests, all of which should be a condition precedent to beginning the work, it sometimes happens that still the concrete or masonry shows poor work. Well, what are we to do then? Condemn the cement? No; suspect the sand, examine the gravel or broken stone, the water, the temperature of the air, the methods of mixing and measuring the aggregates, depositing in place, ramming, etc. After all, the cement is only one of the factors in the problem; for a complete solution we should investigate the whole of them. Do not try the experiment of building works out of cheap, lean concrete, consider the relatively small saving a few barrels more or less of cement amounts to in comparison with the value and importance of the work at stake. Your reputation as engineers will depend upon your capacity to do good sound work.

ECONOMY TEST OF A UNIQUE FORM OF FEED PUMP.*

BY F. MERIAM WHEELER.

During the past few years considerable attention has been given to the subject of steam economy of the auxiliary machinery on steam vessels, particularly those on warships, where a saving of coal has much to do with the steaming radius of the vessel. Under favorable conditions, as, for instance, in the full power trials of the United States warships, it has been found that in the case of the main feed pumps the average indicated horse-power developed by such pumps is about one-half of one per cent. of the I.H.P. of the main engines. I mention this fact to show that feed pumps use more power than any other pumps of a vessel. It will therefore be seen that the feed pump is quite an important auxiliary, and everything should be done to improve its economy in the use of steam. For this reason I have given considerable attention to the subject, and take pleasure in now bringing to the notice of the society the "Economy test of a unique form of feed pump" recently conducted in England, in which the economy was quite remarkable compared with that of the ordinary type of steam pumps usually employed for feeding boilers.

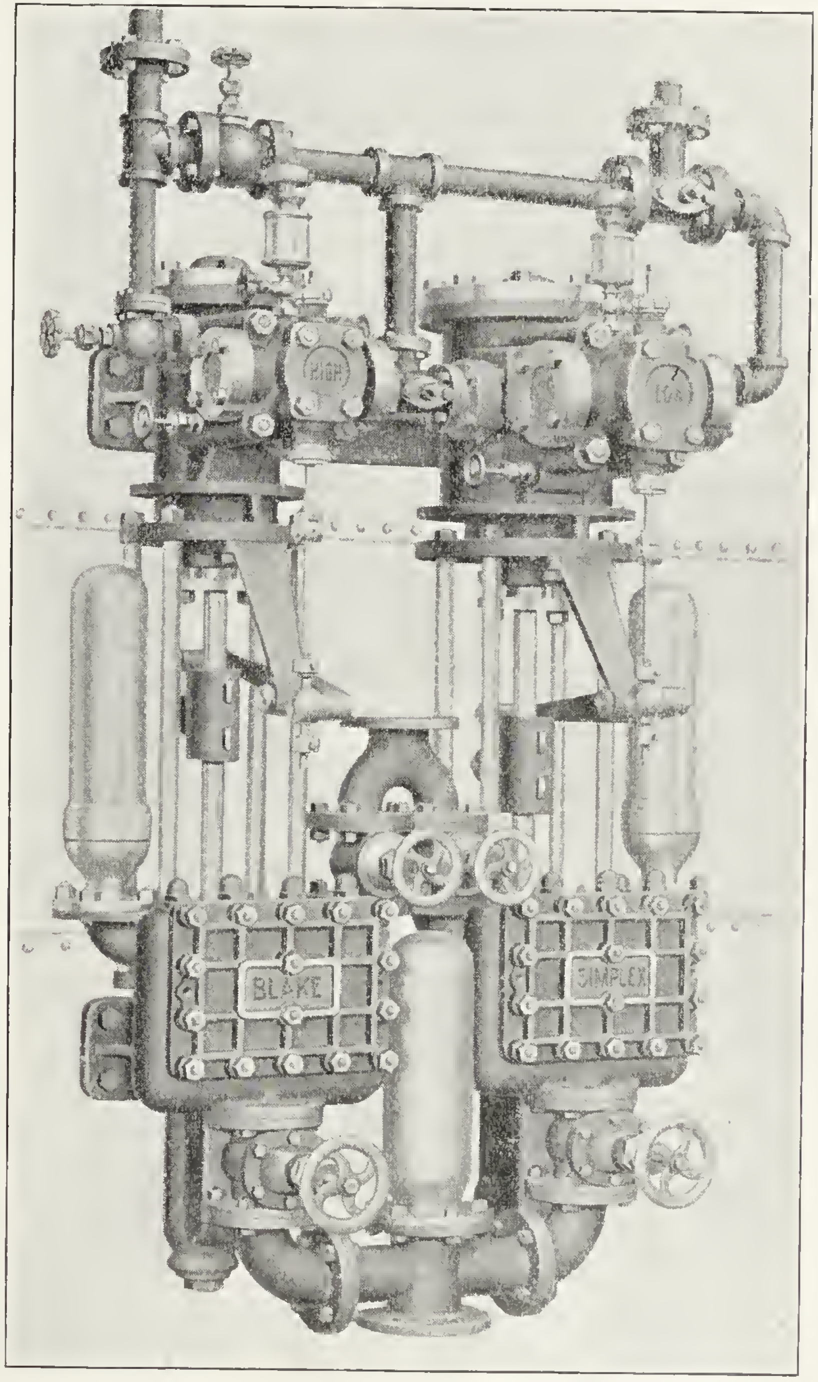

FIG. 1.

Now, it has been shown by tests that the steam consumption of a feed pump of the duplex type will average about 120 pounds weight of steam per I.H.P. per hour. In one test made the very best economy shown in the case of the main feed pumps was a little over 93 pounds, while the poorest showing (i.e., when one of the main feed pumps was supplying the donkey boiler, and consequently running at an abnormally low rate of speed), was over 200 pounds per I.H.P. per hour. The particular pump my paper refers to did its work with an expenditure of only 52 pounds of steam per I.H.P. per hour, which, considering the fact that it was quite a small unit, is a most excellent showing. In other words, this special form of pump uses considerably less than one-half the steam required ordinarily by a duplex pump of the simple type. The test referred to was conducted by experts connected with the engineering department of the well-known engine builders, Willans & Robinson, at their works at Rugby, England, and was for the benefit of the British Admiralty, who were represented by Mr. Antsey, the first assistant of the chief constructor of the Admiralty. There were also present Mr. Keighly, representing Thornycroft & Co.; Mr. Krohn, representing Yarrow & Co., and Mr. Hobbs, representing the Chester Engineering Co.; also Mr. Powel, representing the Blake & Knowles Steam Pump Works, of London. The feed pump tested consisted of a pair of Blake "Simplex" vertical double-acting steam pumps arranged on the cross-compound plan (see engraving of perspective view, figure 1), the high-pressure side having 6 in. diameter steam cylinder, 3½ in. diameter water cylinder, 8 in. stroke; and the low-pressure side having 9 in. diameter steam cylinder, 3½ in. diameter water cylinder, 8 in. stroke. The steam after being used in the 6 in. cylinder was expanded into the 9 in. cylinder; from the latter the exhaust steam was condensed and pumped to the weighing apparatus. Both water cylinders were connected to the one suction pipe having a length of 70 feet with five bends. The height of suction from level of the water in the supply well to the level of the discharge valves in the pump cylinders was 19 feet, to which should be added about 2 feet to represent the friction in the suction connections. The discharge of each pump led into a Y connection as shown, and the discharge pipe was provided with a gate valve sufficiently throttled to put on the pump cylinders a pressure of about 200 pounds per square inch—which, by the way, will be about the pressure these pumps are to feed against when installed in the torpedo-boat for which they were built.

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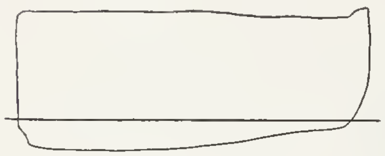
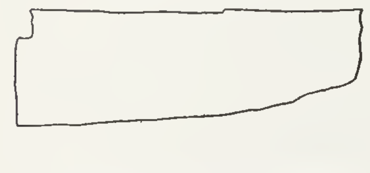
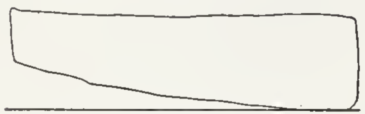
*Extracted from a paper read at the sixth general meeting of the Society of Naval Architects and Marine Engineers, New York, Nov. 1898.



INDICATOR DIAGRAM FROM LOW PRESSURE STEAM CYLINDER, PUMP RUNNING COMPOUND.
SCALE, 50 LBS.=1 INCH.



INDICATOR DIAGRAM FROM HIGH PRESSURE STEAM CYLINDER, PUMP RUNNING COMPOUND.
SCALE, 120 LBS.=1 INCH.



INDICATOR DIAGRAM FROM 6 INCH STEAM CYLINDER, PUMP RUNNING SIMPLE.
SCALE, 120 LBS.=1 INCH.

FIGS. 2, 3 & 4.

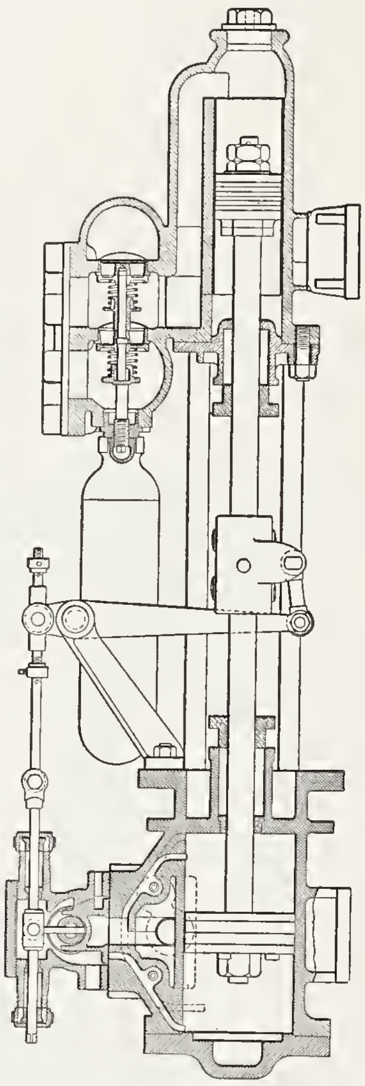


FIG. 5.

I desire to call attention to an important feature of this arrangement of pumps in that it has all the advantages of the duplex system, so far as the continuous flow of the water is concerned, and yet either side can be run as a separate pump in case of accident to the other side. Then, again, the economy of compounding is secured with but two steam cylinders instead of four, as would be the case of a compound duplex pump. Therefore, there is less loss of steam from cylinder condensation; clearance is also reduced to a minimum, as the valve gear of one pump is not operated by the opposite pump, as in the duplex system; consequently, one side can make a full stroke without interference from the other side. The arrangement for testing (excepting the naked pipe that supplied the steam) was as complete and perfect as could be desired. For condensing the steam a surface condenser was employed with tubes having only screwed joints (Wheeler double-tube system), the same being tested to 200 pounds per square inch, so there was no suspicion of leakage. The condensed steam was carefully weighed in a perfectly balanced collecting tank. A small air pump was used simply for drawing off the water of condensation and discharging same to the weighing tanks, forming little or no vacuum. It was the intention of forming no vacuum in order to have this compound pump run under the usual conditions when exhausting into an auxiliary feed water heater—the latest and most economical method in use! The length of stroke could be accurately measured, as metal pointers were attached to the piston-rod crossheads. The length of stroke was easily regulated, as one of the special features of the "simplex" valve gear is the arrangement of the adjustable collars on the valve rods so that proper length of stroke can be obtained for all speeds, even when the pumps are in operation. The testing apparatus of Willans & Robinson's works is one of the most complete and perfectly arranged in Great Britain. The weighing of the water during the test was done automatically by electrically connected attachments, so that great accuracy was obtained and the time observations were taken to a fraction of a second.

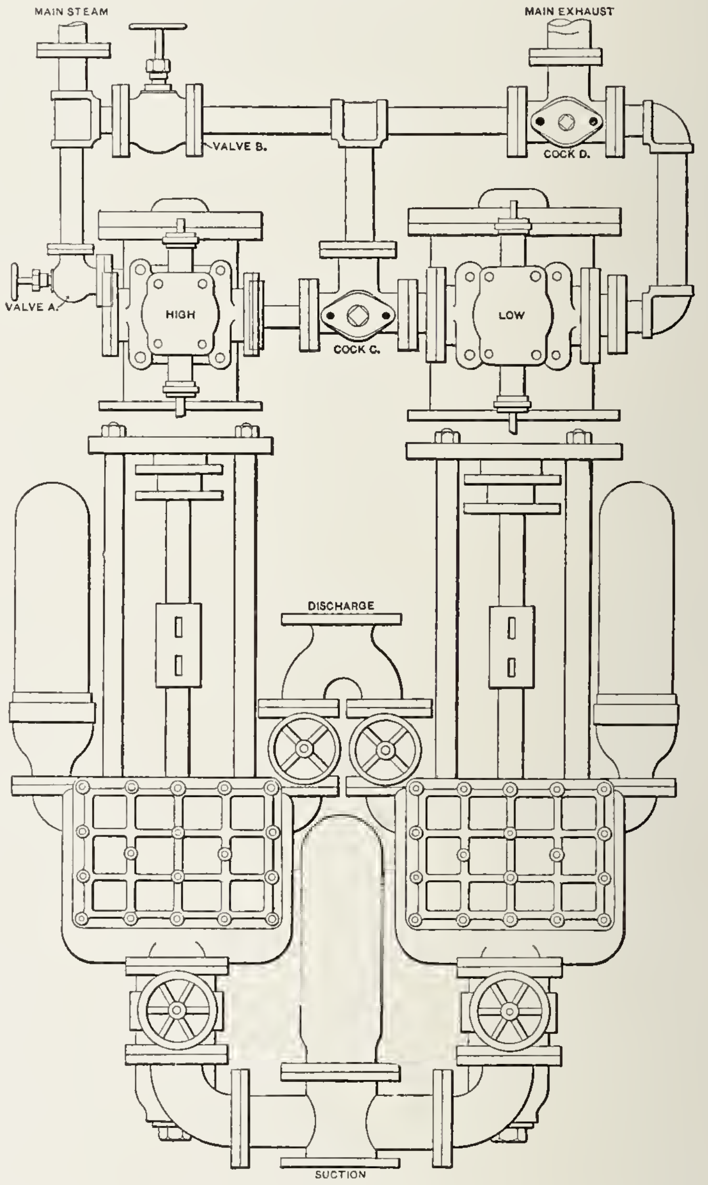


FIG. 6.

Two tests were made—First, by running the pump compound; and, second, by shutting off entirely the low-pressure side and running the high-pressure side as a single pump. As mentioned above, the economy of the pumps when running compound was at the rate of 52 pounds weight of steam per I.H.P. per hour, while the economy of the pump running as a single pump was at the rate of 93.41 pounds per I.H.P. per hour. The former test is designated as "A" and the latter as "B," of which the following are the particulars:

TEST "A."—COMPOUND.

Duration of test	20.55 minutes.
Speed per minute, average for each side	40 double strokes.
Average length of strokes	8.06 inches.
Initial steam pressure per square inch	112.5 pounds.
Mean steam pressure per sq. in. high-press. cylinder	58.06 pounds.

Mean steam pressure per sq. in. low-press. cylinder	30.28 pounds.
Power developed by high-pressure cylinder	2.54 I.H.P.
Power developed by low pressure cylinder	3.07 I.H.P.
Total power developed by both steam cylind's	5.61 I.H.P.
Total weight of water collected	100 pounds.
Weight of water collected per hour	292 pounds.
Weight of water collected per I.H.P.per hour	52.04 pounds.

TEST "B."—SIMPLE.

Duration of test	28.35 minutes.
Speed per minute	54 double strokes.
Average length of stroke	8.05 inches.
Initial steam pressure per square inch	67.5 pounds.
Mean steam pressure per square inch	62.23 pounds.
Power developed	3.961 I.H.P.
Total weight of water collected	175 pounds.
Weight of water collected per hour	370 pounds.
Weight of water collected per I.H.P.per hour	93.41 pounds.

It will be noticed that these tests were of short duration, but they were amply long to demonstrate the economy of the pumps under the conditions given. The so-called system of "Flying test," in the opinion of the writer, is one of the best when the testing apparatus is electrically operated. Indicator diagrams, taken from the steam cylinders when running compound and simple, are herewith shown.

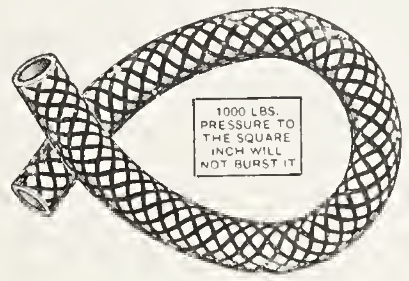
Figure 2 is the diagram from the high-pressure cylinder, and figure 3 the diagram from the low-pressure cylinder when the pumps were running compound; figure 4 shows the diagram from the pump running "Simple" (single pump). The steam-valve mechanism is very simple, and is shown by the sectional view of the pump; (see figure 5). It will be seen that the valve rod (so-called) has no valve directly attached to it as is usual; it merely rotates the auxiliary piston, which latter combines within itself the auxiliary valves. This rotating motion is claimed by the makers to be a great advantage, as it frees the auxiliary piston from possibility of sticking for any reason, causing the pump not only to be positive in its action, but securing uniformity of wear. The rolling movement given this auxiliary piston by means of the "valve rod" and the intermediate swinging pin or tongue, opens and closes the auxiliary ports, which, in turn, control the steam to operate the auxiliary piston, moving said piston back and forth across the main steam cylinder. A plain D slide valve is attached to this auxiliary piston, which valve supplies steam to the main cylinder through the two sets of ports, i.e., the main steam ports and the starting ports. By this cross arrangement of steam chest and valves, a "Simplex" pump can work, it is said, just as well vertically as horizontally.

As regards the amount of steam that can be saved by this system the makers claim that there is no doubt but what the pump will save its own weight in coal in 24 hours' steaming. As an illustration, they state this particular pair of pumps with the attachments weigh about half a ton, and handled during the test at the rate of 17,570 pounds of feed water per hour. Now, this amount of water would supply the boilers necessary to operate a marine engine of the triple expansion type of about 1,100 h.p. The power of the pump as noted in the compound test was 5.61 I.H.P., or about one-half of one per cent. of the power of the engine above given. On the basis of a saving of, say, 70 pounds weight of steam per I.H.P. per hour over and above what would be ordinarily used by a duplex pump of the simple type, it shows a total saving of steam (feed water) of about 393 pounds per hour, or, say, 50 pounds of coal per hour, on a basis of about 8 pounds of water per pound of coal, for the rate of boiler evaporation. This gives a total saving of 1,200 pounds of coal per 24 hours, which, it will be observed, is somewhat more than the weight of the pump, so that I am rather understating than overstating the case. Or, as compared with the single system of feed pump, the cross-compound "Simplex" would save its weight in coal in forty (40) hours. With larger size pumps, and with steam pipes covered, the economy of the "Simplex" compound would be even better than that shown in these tests.

The Mispec, N.B., pulp mill will, it is expected, be in operation by April 1st.

METALLIC FLEXIBLE TUBING.

This illustration shows an article new in the Canadian market and one of great merit. Metallic flexible tubing is devised for the armoring or re-enforcing of rubber hose where great resistant power coupled with flexibility is required. The old method of attaining that end was the using of the best grades of rubber hose of heavy weight, and having it strongly wired. By the use of this new armor, which can be put on the hose by any ordinary mechanic, a three-ply hose is made to withstand the highest steam, hydraulic or compressed air pressure used. It is then claimed to have the durability of steel with the flexibility of rubber hose, and can be made to withstand 5,000 pounds pressure to the square inch. It prevents bursting, kinking and mashing of the hose, and being smooth on the surface is easily drawn over rough ground. Besides being used for hose protection it is adapted for armoring electric cables, protecting the outer insulation and materially increasing the tensile strength where cables are suspended. This tubing can be applied to the inside as well as to the outside, when desired for suction hose. The value does not only consist in the safety feature, but is claimed to be an economizer on rubber hose expense to the extent of 80 per cent., besides preventing loss of time, and guarding against accidents so often caused by bursting hose. It is made of fine, tempered, flat steel wire, galvanized, and as it is made in long lengths, can be cut as desired. Samples for testing purposes, price list and discounts may be obtained from the Canadian agents, Darling Bros., Reliance Works, Montreal.



THE MONTREAL, OTTAWA AND GEORGIAN BAY CANAL.

The subject of the Ottawa Valley route for western traffic to Montreal was discussed at the recent meeting of the Canadian Society of Civil Engineers in a long and comprehensive paper by Henry K. Wicksteed, Mem. Can. Soc. C.E. As The Canadian Engineer has already taken up this subject somewhat extensively, it is not necessary to reproduce the whole of Mr. Wicksteed's paper, but merely summarize some of the leading arguments which we have not before taken up so fully. The claims of the route as a natural trade outlet are strongly urged and the question of strategic value is also gone into. When Mr. Wicksteed was a boy, brigades of Northwest canoes still started from Lachine, ascended the Ottawa, skirted the North shore of Lakes Huron and Superior, and then made their way through the labyrinth of lakes and rivers between the latter and Lake Winnipeg. Coming down to modern times, the Ottawa Valley was accepted without question as the route for the Canadian Pacific Railway. But the settlement and rapidly growing wealth of the southern portion of Ontario fronting on the two lower lakes, the comparative non-progress of the central plains west of the Red River, and the demands of local trade, led to the construction of the Welland and the Rideau canals, and later of those on the St. Lawrence itself. And although, in 1858, the Ottawa river was examined with a view to further extension of canal navigation, and favorably reported upon, it was deemed that the times were not ripe. Still later, and bearing directly upon the question at issue, is the completion of the Ottawa, Arnprior and Parry Sound Railway and the enormous traffic developed by it. Showing that, in spite of "vested interests" and "established trade routes," trade is eager to avoid the long circuit of the St. Clair river and flats, and the dangers and difficulties of navigating them, and of the Detroit river and its mouth.

The Ottawa river is in its lower stretches below the city of Ottawa, a series of broad shallow stretches, flowing over flat limestone rocks belonging to the lower Silurian group. Almost immediately above Ottawa it loses this character, and becomes a Laurentian river, consisting of a number of deep, almost currentless pools, separated or connected by short abrupt falls and rapids tumbling over the hardest of solid rock. The same applies to the Mattawan, and, in an even greater degree, to the French river. The navigable reaches now existing are almost ideal ones, it is stated, with scarcely any improvement, deep and broad enough to admit of high rates of speed with vessels of considerable draught and magnitude. The one important exception to the prevalence of hard granitic or syenitic rocks at the salient points is that of the summit or divide between Trout Lake on the Mattawan and Lake Nipissing, which is largely, if not wholly, composed of drift, the summit being only three feet above Trout Lake and 27 feet above Lake Nipissing. In view of the moderate depth, this is probably the one point at which he would prefer sand cutting to solid rock, as the two lakes would be brought to the same level, and this somewhere near the present high-water level of Nipissing. In connection with the water supply about which some doubt has been expressed, owing probably to a misapprehension of the meaning of a clause in Mr. Shanly's report of 1858, Mr. Wicksteed states, that Mr. Shanly and Mr. Clarke both describe the supply of Lake Nipissing as being inexhaustible, and Mr. Clarke goes into more details, and says: "The quantity of water flowing from Lake Nipissing at a low stage was found by careful gauging to be 9,500 cubic feet per second," or 820,800,000 cubic feet per 24 hours, to which must be added the volume of the Mattawan. And he further remarks that this is equivalent to 5,472 lockages of 250x50x12 in each 24 hours. And, finally, "this sets at once at rest any idea of the necessity for a storage reservoir."

It is suggested by the author that in view of the fact that alternate channels exist in many cases, as in almost the whole of the French River, it would be quite possible, and he believes in a majority of instances much cheaper, to use the bed of the river itself for the lock chamber and allow the surplus flow to find its way through the other channels. Downwards through the Mattawan and its lakes and the Ottawa and its expansions to the foot of Deep River the topography is almost constant in its character, and the methods of dealing with obstructions the same throughout. Controlling dams to retain the levels as nearly as may be the same at all stages of the water and short canals with locks at various points. The narrowness of the canyon and the rocky nature of its walls would, it is thought, make it peculiarly easy to drown out minor differences of level and to concentrate the fall within a short distance. Below the Deep River the Ottawa expands into the Allumette Lake, the improvable channel lying to the north of the Allumette Islands by the Culbute channel. Lower down is the Coulonge Lake, and below this the Portage du Fort, embracing a series of rapids and falls extending to the town of that name, giving an aggregate fall of 98 feet in a distance of 10 miles, the most rapid pitch found on any part of the river below Mattawan. The methods of dealing with these falls is the same as for others, drowning out the smaller ones by means of dams, and connecting the pools so formed by short canals and locks. As in the case of the French River, the existence of parallel channels render the improvements easier of accomplishment than they would otherwise be. Below Portage du Fort comes Chats Lake, 18 miles in length, and with the exception of a couple of minor obstructions of good depth (not less than 25 feet) throughout. At the foot of Chats Lake are the Chats Falls, 50 feet fall in 3 miles. Here again the river is divided by islands into many channels, and the same methods of construction are available with a total length of canal only 6-10 of a mile. The river then enters Lac des Chenes, 26½ miles long, with a general depth of from 20 to 30 feet with some few short bars covered by less water, and is now clear of the Laurentian rocks, and the river enters a limestone country which continues to its mouth. Below Lac des Chenes the river drops 60 feet in a distance of 6½ miles. At Ottawa city very considerable works will be necessary, but below the city the present navigation for light draught vessels already exists, and has been treated of before in these columns. It is suggested that the canal should reach Montreal by the Back River, thus creating very valuable water power. A hint of possible developments in power is given in the statement that the low water flow of the Ottawa at Mattawa is 25,000 cubic feet per second; its elevation at that point is 500 feet above the sea. Without counting on tributaries and increase of volume, this represents a total horsepower of 1 1-3 millions, or, reckoning on a 10-hour instead of a 24-hour day, of over 3 millions. Mr. Wicksteed concludes his paper by again calling attention to the breadth and scope of the project, and that it is not a matter of local development or even of the advancement of the Dominion of Canada. It concerns the Empire and the neighboring Republic, and will affect rates and prices over at least one-half of the North American continent. It is not a competitor in any sense with the railways, for it will, as Sir William Van Horne has said, bring them more traffic than it will take away. As we have seen in the case of the Sault Ste. Marie lock, a large portion, if not the major portion, of its traffic will be of its own creation, and of such a nature as could not exist without it.

SERIES ARC LIGHTING.[*]

BY W. H. TURBAYNE, E.E.

Although the arc light first made its appearance about the beginning of the present century, it is only within the last quarter of a century that it has become generally adopted as an illuminant. About the year 1802 an Englishman, Sir Humphrey Davy, conceived the idea of opening an active electric circuit between two points of carbon. He had at his disposal some 2,000 cells of a simple primary battery, which he connected in series, and from the extreme terminals he brought wires to the ends of which were connected small pieces of charcoal. These he touched together and afterwards drew apart, and in so doing the current bridged the gap which was made, appearing as a flame having powerful heating properties and causing the charcoal tips to glow to an intense whiteness. Thus appeared the first true arc light.

The charcoal points were evidently held in a horizontal position as the stream of vaporized carbon appeared in the form of an "arch," being impelled upwards in the centre by the ascending currents of air; from this phenomenon we derive the name "arc" light. About thirty years after this discovery of Davy's, Michael Faraday discovered and promulgated the principle of electric-magnetic induction. He found that when a steel bar magnet was passed through a coil of wire, properly arranged, a current of electricity was momentarily induced in the coil, which manifested itself similarly as the current from a primary battery, and this important discovery soon led to the development of the dynamo machine for producing powerful currents. Previous to the introduction of these dynamos the arc light was seldom seen outside the laboratory, the expense and annoyance, coupled with the use of acid batteries prohibiting its most extended adoption. With the advent of the dynamo renewed interest was taken in the development of the arc light. Mechanisms called lamps were devised for feeding the carbons together as they wasted away and improvements were introduced into the current generators so that an uninterrupted light could be maintained for considerable periods. Even at this time, however, the usefulness of the new light was limited, as it was found that the feeding of the lamp so affected the current in the line that only one lamp could be operated on a single circuit, and that it was only in certain isolated cases, such as in light-houses, that the light became of value. This was the condition of affairs until some forty years later, when in 1875 Chas. F. Brush, of Cleveland, U.S.A., and others discovered the principle of differential regulation, which made the operation of several lamps on one circuit and machine possible, and made each lamp an independent unit as regards its feeding properties.

It is not our intention in this paper to follow the art of arc lighting from the date of its inception, and to successively note the advances which have been made in bringing this method of illumination up to its present state, but to offer a brief exposition of the cardinal principles involved, and to shortly describe the functions of the mechanisms employed in a modern system of series arc lighting, in which a direct current of constant value is employed, a system which has been developed since the introduction of the differential lamp of 1875. Such a system virtually comprises a current generator or dynamo, a number of arc lamps and an arrangement of conductors interconnecting the whole in such a manner that the current on leaving the dynamo enters the first lamp and thence passes to the next, and after having successively traversed all the lamps in like order returns to the dynamo, the path of the current therefore being in one continuous circuit within which the total electrical energy produced by the generator is expended. If we take a pair of carbon rods and introduce them into an active electric circuit as above, no light will be emitted until a separation of the carbons takes place, and we find that, with the current strengths adopted in practice, a separation of approximately one-eighth of an inch gives the best results as being free from objectionable hissing or flaming. Such an arc requires for its maintenance an electro-motive force or pressure of about 45 volts, which represents an energy of something over ½ h.p. This energy is expended, in part, in overcoming the resistance of the arc gap, but the greater part appears in the form of heat and the resulting temperature is so concentrated and intense as to cause a vaporization at the surface of the positive carbon, which in the process is brought up to a highly incandescent state, this being in reality the source of light. This vaporization and a combustion of the carbons is accompanied by a gradual wasting away and consequent shortening of same, and in order, therefore, to maintain an uninterrupted light means must be found for feeding the carbons together at a rate proportional to this consumption.

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[*] A paper read before C. A. S. E., Hamilton, No. 2.

An arc light, therefore, is substantially a mechanism for initially separating the carbons a predetermined distance during continued operation. In studying the arc lamp we will not touch on the innumerable mechanical devices, such as racks and pinions, brake wheels, clutches and bands or chains, which are employed with the one view of gripping and releasing the carbon under the control of the actuating magnets, but we will describe the action of an ideal differential lamp, such, in fact, as may be taken as a representative of the types in extended use. The carbons are separated by an electro-magnet in the main circuit through which the whole current passes, while the feeding is effected by another electro-magnet acting in opposition to and tending to overcome the lifting action of the first. The second magnet is provided with a high resistance winding of fine wire and is connected as a shunt across the carbons, and therefore exerts a greater or lesser influence, accordingly as the carbons are more or less widely separated. Therefore as the carbons are consumed the arc increases in length and coincidently the second magnet opposes the action of the first until finally it overpowers it and allows the carbons to feed forward. In practice so fine a balance is obtained between these two magnets that the carbons are continually feeding forward in imperceptible degrees.

There are, of course, numerous modifications of this principle introduced into different lamps, but, nevertheless, their electrical actions are similar, inasmuch as the separation of the carbons is brought about by the action of the main current itself, while the feeding is accomplished by the action of the circuit derived from this and having as terminals the upper and lower carbons. We may here state that the illuminating power of an arc lamp varies with the electrical power which is expended within it. This electrical power, expressed in watts, is the product of two factors, the electro-motive force or pressure, and volume of current as expressed in the terms volts and amperes respectively. We have seen that the function of the arc lamp is to look after one factor, viz., the pressure or volts across the terminals, consequently in order to produce an unvarying light we must keep the other factor of current volume constant.

The function, therefore, of the generator or dynamo is to furnish a current of constant strength, and, as the lamps are connected in series, and as each demands some 45 volts as explained, it must operate at a pressure sufficient to maintain the number of lamps for which it was designed to operate, together with sufficient marginal pressure to overcome the resistance of the copper lines connecting same. An arc lighting dynamo, like most other dynamos, consists essentially of an arrangement of copper conductors wound over an iron core and rotating within the influence of the poles of a powerful electro-magnet, but, as contrasted with constant pressure dynamos, which include those used in operating incandescent lamps in multiple and those used in furnishing current to stationary and street railway motors, it must possess peculiar properties, which are required to adapt it to the running of arc lamps on series, and notable among which is that a fall of current below the normal strength must be accompanied instantly by a rise in voltage and likewise with an increase of current the voltage must fall. We may here state that while the function of a constant pressure dynamo is to keep the electro-motive force or pressure factor constant, while the current is variable, the constant current or arc dynamo, on the other hand, must keep the current factor constant while the pressure is variable.

In such a machine the magnets are series wound, and the energizing windings are traversed by the full current passing through the circuit of lamps. The iron magnet cores are so proportioned as to be magnetically saturated, that is, are worked to such a high degree of magnetization as to be insensible to slight changes in the strength of the current which energizes them. On the other hand the rotating armature is wound with a number of turns of wire and in reality constitutes a powerful magnet, which is sensitive to current changes, and which meanwhile reacts against and partially controls the magnetic field, which induces the current within itself. As therefore the switching off of a lamp, or the feeding of several lamps at once, would cause the current to rise, the armature magnetization would increase perceptibly, while that of the field magnet would not do so, the former would, therefore, so react against the latter as to reduce the effective magnetic strength and the voltage therefore would fall; the reverse action would likewise take place should one or more lamps be switched on.

In order that this inherent regulating property will be effective over the whole range of the machine, automatic current regulators are employed, which by moving the collecting brushes around the commutator, or by adjusting the field strength, so adjust the electro-motive force and incidentally the current strength as to meet the conditions of the outside load and further assures sparkless operation at the collecting brushes. The power required to drive an arc dynamo will be in proportion to the number of lamps burning at any time, and will vary as the number of lamps in operation. As we have stated that the electric power is the product of the current volume and the electro-motive force, and as the former factor is constant the power delivered will vary, therefore, as the latter factor, which varies only as lamps are added to or withdrawn from the circuit. Arc dynamos, unlike constant pressure dynamos, do not necessarily demand the refinements in speed governing in the movement which drives them, as the inherent regulation of the machine itself will look after any such irregularities as are met with in practice and in fact, with the brushes locked in a fixed position, constancy of current during change of load may be obtained by varying the running speed only. There are other accessories such as automatic lamp cut-outs, which ensure continuity of the circuit should a lamp be defective; lightning arresters for protecting the lines and station apparatus; and loop switches for controlling groups of lamps, which we cannot now cover in detail and which, although essential to the satisfactory and safe operation of such a system, yet are not necessary to the production of the light itself, the generator and lamps being the indispensable adjuncts of a series arc lighting system.

THE PRACTICAL MAN.

Improvement in the Manufacture of Steel Wool.—There is now an established demand for steel wool, and its manufacture is in successful operation. The process by which it has heretofore been produced consisted in clamping together a number of circular disks of thin sheet steel, slowly revolving them, and then with a sharp-edged flat tool taking off thin shavings from the edges of the disks until they were all converted into "wool." The improved process, lately patented, consists in winding a long sheet of thin sheet steel into a tight roll, and then using a flat cutter to shave the " wool " from the end of the roll. This latter process is evidently the cheaper, involving both less labor and less waste of material.

Rubber Packing.—Where rubber packing is used, it will last many times longer and not blow out, if a piece of common wire screen (same as used in window screens), is put on each side of the rubber. It embeds itself in the rubber and holds it together, so that when hot and soft, it cannot blow out.

Case Harden Cast-Iron.—Heat to a red heat, roll in a composition consisting of equal parts of prussiate of potash, sal ammoniac, and saltpetre, pulverized and thoroughly mixed. Plunge while yet hot into a bath containing 2 ounces of prussiate of potash and 4 ounces of sal ammoniac to each gallon of cold water.

Tempering Liquid.—Water, 3 gals., salt, 2 qts., sal ammoniac and saltpetre, of each 2 oz., ashes from white ash bark, 1 shovel full. The ashes cause the steel to scale white and smooth as silver. Do not hammer too cold. To avoid flaws, do not heat too high, which opens the pores of the steel. If heated carefully you will get hardness, toughness, and the finest quality.

To Weld Cast-Iron.—Take of good clean white sand, 3 parts; refined solution fosterine and rock salt of each 1 part; heat the pieces to be welded in a moderate charcoal fire, occasionally taking out and dipping into the composition, until they are of a proper heat to weld. Then lay at once on the anvil and gently hammer together. If done carefully by one who understands welding iron, they will be nicely welded.

Bluing.—Ten lbs. saltpetre, 1 lb. black oxide of manganese. Heat (in a crucible) to a point that will ignite pine sawdust, stir thoroughly. Suspend work in a wire basket (keeping basket in motion), until proper color is obtained.

In laying out work on planed surfaces of steel or iron use blue vitriol and water on the surface. This will copper-over the surface nicely, so that all lines will show plainly. If on oily surfaces, add a little oil of vitriol; this will eat the oil off and leave a nicely coppered surface.

Put a piece of resin the size of a walnut, into your babbit; stir thoroughly, then skim. It makes poor babbit run better, and improves it. Babbit heated just hot enough to light a pine stick, will run in places with the resin in, where without it, it would not. It is also claimed that resin will prevent blowing when pouring in damp boxes.

To make a tap or reamer cut larger than itself.—Put a piece of waste in one flute, enough to crowd it over and cut out on one side only. In large sizes (½-inch or over) put a strip of tin on one side and let it follow the tap through. You will be surprised at the result.

NATIONAL ASSOCIATION OF MUNICIPAL ELECTRICIANS.

A meeting of the executive committee of the Fire and Police Telegraph Superintendents' Association was held in Boston on January 28. The object of the meeting was to revise and amend the constitution and by-laws in accordance with the resolution passed at the third annual convention at Elmira, N.Y., and to outline the arrangements for the next annual meeting which takes place at Wilmington, Del., September 5 and 6, also to suggest topics for papers to be presented at that meeting. It was decided to change the name from the International Association of Fire and Police Telegraph Superintendents to the National Association of Municipal Electricians, which title renders eligible for membership all officials engaged in the electrical departments of municipalities throughout America, instead of only those engaged in the fire and police telegraph departments as heretofore. The associate members are composed of manufacturers and dealers in apparatus and appliances relating to the interests kindred to the association.

SOME METHODS OF SEWAGE DISPOSALS.

BY W. M. WATSON, TORONTO.

For The Canadian Engineer.

In an article on sewage in the October issue of The Canadian Engineer reference was made to the sewage purification systems invented by the late Geo. E. Waring and Jerome Deery, the latter system being the one adopted at Reading, Pa., U.S.A. As the writer did not fully describe the processes it may be interesting to explain the methods employed. The Deery's system is divided into two parts. First, the screening or sieving process, and afterwards the filtering. The raw sewage of the town is led from the central outfall into a tank made circular, or any shape or size suitable to do the necessary work. About two feet from the concrete floor there is a permanent fine grating fixed that fills the whole tank space; on the top of this grate cinders, coke or the breeze of coke is spread to a thickness of over 8 inches. Then on top of the coke there is another fine grating laid on light girders. A little above the top grating one or more half round troughs are carried across the tank, whose top edges are turned over like the rolled edges of a cast-iron bath, and the sewage is brought to the screen from the sewer by way of these troughs, and overflows over both edges in a very thin stream, dropping on the fine iron grating, which retains the floating matter, while the heavy solids remain in the bottom of the half round or D shaped trough; it then worms its way downward through the bed of coke, and drops through the lower grate to the concrete floor, where it is collected and sent to the filters in pipes.

Each tank is carefully enclosed over the top of the troughs, which forms an air space between the top cover and the face of the upper grating, and between the lower grate and the floor. This open space is used to aerate the sewage as it is falling from the troughs to the upper grate, and as it drops from the lower grate to the floor. The atmosphere is introduced into the two spaces by air passages extending from one side of the tank to outside the building—they are like the air chutes serving a hot air furnace—and on the opposite side of the tank there are corresponding air flues extending to an annular hot-air flue constructed in the long chimney that serves the steam boiler. The smoke and heat pass up the centre of the chimney through the interior of an iron tube or tile pipe, and all around this iron tube there is arranged a wide space, i.e., an annular flue, which attracts a large amount of heat from the central smoke tube, and the heat causes a keen draught; thus all the sieving tanks have a strong current of fresh air continuously passing both under and over the bed of screening coke, with the object of aerating and supplying oxygen to the sewage as it is distributed on to the upper grate, and when it is discharged from the lower grate to the floor. After aerating the sewage the air passes onward and upward through the annular flue of the chimney to the outside.

The coke sieves soon become choked with dirt and fat contained in the sewage, and when necessary the troughs and upper grating are removed, then the wet, dirty coke is taken out and conveyed to a brick vault having a graded floor, over which a false floor is constructed of iron pipe or bars covered with fine wire netting; on this floor the wet coke rests. All round the vault walls are covered with 1-inch steam heating pipes, and there is a flue to convey the vapor to the annular flue of the chimney. When all the dirty coke is removed from the sieving tank to the drying vault the doors of the vault are closed, and high pressure steam from the boiler is passed into the interior pipes, which quickly heats up the coke; the fat melts and dropping to the floor is afterwards collected, placed in barrels, and disposed of. The wet is evaporated and passes up the chimney, and the dirt is dried into fine dust, and afterwards (the inventor informs us), the coke can be re-used for sieving purposes, or used for fuel to generate steam, and in this way the inventor gets rid of the sludge difficulty, which in many other processes is very troublesome. This is certainly a better method than using pumps and sludge presses, though it will be expensive; but the expense might be reduced considerably by dropping the aerating features and all the appliances used for that purpose, because it is of no advantage to aerate sewage during the time it is passing through the sieve and getting screened, in fact, experience has proven that if both air and light are excluded at that time better results are obtainable.

We now come to the filtering process. The filters are built on two flats; one set of filters is constructed immediately over the other, having an air space of over 8 feet between the top of the floor filters and the underside of the elevated filters, which are built on pillars and cross girders, and the reservoirs or filter tanks are constructed in sizes suitable for being easily cleaned or repaired. The sewage from the sieving tanks is conveyed in pipes resting on standards fastened to the tank partitions, and from the pipes the sewage flows over D shaped troughs carried across the surface of the filter—one trough about every 2 or 3 feet—in such a way that the sewage falls on the filtrate evenly and in thin films, thus securing another aeration before entering the bacteria filter, which should kill any putrefactive bacteria that may be left in the sewage. Whether this is any advantage or not I will leave others to judge, but we know that the putrefactive bacteria is food for the purifying bacteria, and on that ground the filter seems to be the place where they ought to be destroyed. The bottom of the higher flat of filters is fine open grating on which the filtering material rests, and as the sieved sewage passes downward through the filtrate it drops out through the porous grating and falls on top of the filtering material contained in the floor filters, in drops, or fine spray, and in this way the fluid is expected to secure another good airing. Under the filtering material of the lower or floor filters there is a net work of tile pipes graded in sections, in a way that the highest point of each branch terminates in the centre of each filter tank, and all the branches draining each filter are connected to a ventilating tube, extending from the head of the combined drains, upward, through the centre to about two feet above the surface of the filtering medium. The object of this is to draw away the light gases and introduce the heavier oxygen to the underside of the filtering material, and to ensure this being done all the drain pipes are perforated with numerous holes, and the discharge ends terminate into a large open culvert from which any amount of atmospheric air may be drawn. Filters built one over another, with open air spaces between each other, were used in England several years since, and found of no advantage whatever; because the only agents that properly purify sewage and prevent it ever after setting up putrefaction, are the reducing bacteria, and the exposure of the sewage for a sufficient length of time (not less than 30 minutes), to the action of the oxidizing organisms that have a proper resting place made in a way that every particle of fluid is compelled to pass in front of the microbes, which are so small that Dr. Richards has proved that it takes a billion and a quarter to weigh one grain. This bacteria workshop is named a filter, and the filter, like every other healthy workshop, must be well and properly aerated to supply the organisms with at least three times the bulk of air to one of sewage, or perfect purification must not be expected. Therefore, if any person gives his whole energy to aerating the fluid sewage itself, and ignores the value of aerating the filter or microbe workshop, he cannot discharge a purified effluent of sufficient purity to be safe, and the discharge from his works will probably afterwards set up putrefaction that will undo any work previously done. The writer of the October article states that 1,143 gallons of sewage is passed through each square yard of filter space per day. In that case then the filters are not bacteria filters, but simply sieves that fine the fluid and extract the solids, but cannot purify the sewage. First, because bacteria could not hold their position in a filter having such a rapid stream passing through it, and if ever any of the microbes should secure a lodgment in the filtrate material they would be washed out and forced along with the stream. Second, even were it possible that such filters could be charged full of purifying bacteria they would not have sufficient time allowed, with such a rapid stream rushing through them to do much, if any good work.

It is almost idle to expect that more than about 200 gallons per yard per day of 24 hours' continual working, can be well purified by the microbes, even when properly housed in a well arranged filter composed of ⅜-inch or ½-inch cubes of coal, clinker, coke, gravel or other hard material, and when the oxygen is introduced by mechanical appliances regularly and evenly throughout all the intersections of the filtrate material. So that the system will need a filtering area about six times larger than described to ensure an effluent that will be properly purified in a way that it cannot afterwards set up putrefaction and nullify the work previously done. This is the opinion of experienced experts, and will also be shown by the description of Col. Waring's system hereafter described.

Geo. E. Waring's system consists of cleaning sewage by purifying bacteria, and is quite different to such methods as Cameron's, of disintegrating and fermenting the sewage, to split it up into particles and let free the gases in a primary settling tank, using the anaerobic microbes for the purpose, before the sewage is sent to the bacteria filters to be purified by the aerobic or purifying microbes. It is also different to Lomax's process of intermediate flushing, practised at Chorley, Eng., by the International Sewage Purification Co., of London, Eng., which was fully explained in several of the back numbers of this paper, and to a committee of the Toronto and London city council early in the present year, and again dwelt upon on page 221 of the December number.

The Waring system, and also the Deery system, does away with the very expensive practice of collecting, pumping and pressing the sludge, for they each destroy it; nor do they follow the Chorley example of using expensive precipitants, a method which is fast dying out, and is only necessary where the sewage has a large amount of tenacious chemicals in it, which is seldom or never in Canada. Col. Waring uses mechanical appliances to force air into the filter, and between all the interstices of the small cubes stored in the filter, continuously, and by so doing he supplies the bacteria housed in the filter with all the oxygen they require, without stopping the flow of sewage on to the filter to be aerated, as is done by the Lomax system of intermediate flushing, and then stopping the flow, and allowing the filter to stand idle for a period. On this ground it is held by the inventors of the forced draught or continuously aerating system that double the work can be accomplished than can be done by the Lomax intermediate system.

This mechanical method of aerating sewage filters was first invented and patented by Sidney R. Lowcock, 35 Waterloo street, Birmingham, Eng., about 1897, and lately taken hold of, and, I believe, patented in the United States by the late Col. Geo. E. Waring, jr. The way Mr. Waring applies the process is very ingenious and worth studying, for he very properly avoids showy and expensive arrangements and appliances; he also studies to assist nature to do the work rather than copy the example of many engineers, who put expensive obstacles in the way of the little bacteria doing the work they were created and appointed to do. Therefore, the process can claim to be a natural system, which cannot be said of others that have been described. He first collects the raw sewage into an elevated tank, and from this tank the sewage flows by gravitation through pipes to each roughing filter, which sieves the sewage, and at the same time gives ample time for the anaerobic bacteria to do their part of the work of cleansing the sewage before being totally destroyed themselves. These roughing filter tanks are in two divisions, divided by a light partition into two halves, which extends from the top to about 6 inches from the bottom. At this point there is a false bottom of grating or bars on which about 3 or 4 feet in thickness of coke is placed, and the sewage passes downward through the coke on one side of the middle partition, then bends under the bottom edge of the partition, ascending through the coke of the other half of the tank, afterwards overflows in a thin film over the lip constructed on the side of the tank, where it receives some aeration, then it is distributed by suitable channels, evenly over the surface of the filters.

These roughing filters like Deery's sieves get clogged with dirt and fat until the sewage refuses to pass through the coke, then the sewage is turned on to another pair of roughing filters, and the sewage remaining in the tank is drained out of the clogged coke by an outlet at the bottom, and when quite empty a strong current of air is forced into the vacant space between the concrete and the false grated bottom, and is gradually forced upward through the interstices between the particles of coke, which in time supplies oxygen necessary to start bacterial activity, and oxidization at once begins, and the accumulated filth and fat is destroyed by the purifying organism (so Col. Waring assures us), and in this way he gets rid of all the sludge extracted from the sewage at a trifling expense of running a fan by electricity. This is a big step in advance of using precipitants and sludge presses. The filters are filled about 3 or 4 feet thick with small crushed and sieved coke, covered about 2 inches thick with clean, fine sand to prevent the sewage from entering the coke in the filter quicker than the bacteria can purify it, so in reality the sand is made to act as the regulating valve, to measure and distribute the sewage in needed quantities to the bacteria lodging in the cells of the coke filtrate below.

Underneath the coke there are placed perforated tile pipes on the fish bone plan, which do double duty, for they collect the effluent falling from the coke filter and convey it through an interception trap (which is here necessary to prevent the escape of air that is discharged by the fans to the filtering material) to the culvert carrying the effluent away, and they also form the carrying flues to distribute the air from the fan to the underside of the filtrate, and it is distributed at a pressure sufficient to force its way upward through the intersections of the 3 or 4 feet of small coke and the 2 inch blanket of sand, efficiently removing all the hydrogen generated by the bacteria, and supplies them with plenty of oxygen to maintain their constant activity. Thus when the filter has got filled with the purifying bacteria it needs only to have the sewage carefully and slowly distributed evenly over the surface, and wind at a proper pressure continuously forced up through the filtering material from the bottom; and it will continue to work forever, without any cleaning, raking or disturbing in any way, but stop the wind for a short time or increase the flow of sewage to 1,100 gallons per yard a day, and out will go the valuable bacteria with the rapid stream, and the filter will be worthless until another set of bacteria is bred and installed, which would take at least two months.

The value of a filter well stocked with the purifying bacteria is very great, and needs careful handling, therefore every appliance must be duplicated and constantly watched, so that should any accident or stoppage occur, another set can be at once started to take the place of the disabled apparatus, and prevent the life of the microbes from being jeopardized. There are simpler methods than either of the three above described that have worked for years giving a fairly pure effluent, but their simplicity prevents them being noticed, for people looking for such sewage purifying systems look for something large and intricate, requiring a number of hands. The one at Chorley is among the most expensive ones, both in plant and management.

DEGREES IN SCIENCE AT MCGILL UNIVERSITY.

The Corporation of McGill University has decided to grant the degree of B.Sc. (Bachelor of Science) in the faculties of arts and of applied science. Candidates for this degree in the faculty of arts must pass a matriculation examination in English, with history; another language, mathematics, and either physics, chemistry, botany, physiography, an additional language and additional mathematics. In the faculty of applied science additional mathematics (including trigonometry) must be taken at matriculation, and the above options are not allowed. These regulations apply only to the examinations for this and next year. In 1901 another language will be required in both sections, with the option of elementary science in the applied science faculty; and it is hoped by that time the matriculation examinations in both faculties will be placed on the same footing. Candidates for the B.Sc. in the faculty of arts who intend to take medicine must take Latin as one of their subjects at matriculation. A board of matriculation examiners was appointed to control the matriculation examinations in the various faculties, and assimilate the conditions. The B.A. Sc. degree (Bachelor of Applied Science) is changed to B.Sc. Graduates who have taken the former degree may retain that title or drop the word "applied," at their choice.

The B.Sc. students in the faculty of arts will take the following course: First year, English, French, German, mathematics and physics. Second year, English, logic, French, German, chemistry and mathematics or botany or zoology. In the third and fourth year the B.Sc. student will specialize in selected groups of the following subjects: Mathematics, physics, astronomy, chemistry, zoology, botany, geology, physiology, human anatomy. In the B.Sc. diplomas the word (arts) or (applied science) will appear in the diploma to indicate the faculty in which the candidate has prepared for his degree. The M.Sc. will be granted to Bachelors of Science in both faculties, and to Bachelors of Arts of (a) at least one year's standing, provided that they have for one year taken a graduate course of study in science, previously submitted to and approved by the faculty; have passed an examination at the end of the year; and have, if required of the faculty, presented a satisfactory thesis; or or (b) at least two years' standing, if they have not taken a graduate course of study in science, provided that they have presented a satisfactory thesis, and passed a special examination for graduation. In the faculty of applied science the M.Sc. will supersede the degrees of Ma. E. (Master of Engineering), and M.A.Sc. (Master of Applied Science). The degree of Doctor of Science (D.Sc.) will be granted to those who have already taken the degrees of M.A., M.Sc. or M.D. It will be given for scientific attainments or research work submitted to the faculty. It will not be an honorary degree, and will only be open to graduates of at least five years' standing.

—The Self-Propelled Traffic Association, of Liverpool, England, has determined to hold another series of trials of motor vehicles for heavy traffic, probably in September, 1899. The previous tests held under the auspices of this association were conducted last year from May 24 to 27. Those interested should address the secretary of the association, E. Shrapnell Smith, Royal Institution, Colquitt street, Liverpool.

REFRIGERATING MACHINERY.

J. & E. Hall, Ltd., inform us that their orders for machines to be fitted on board ship have been well maintained throughout the year, besides a large number for land, this being notwithstanding the fact that they have produced these machines at an average of fourteen per month. At the present time their orders in hand amount to 84 machines to be supplied for ships, and the orders for land machines have also increased. They mention a few of those ordered: For H.M. Admiralty, machines for H.M.S. "Ocean" have just been completed, and those for H.M.S. "Canopus" and H.M.S. "Andromeda" are in progress. The following additional ships are to be fitted: H.M.S. "Formidable," "Pandora," "Bulwark, " Sheerwater." Other machines are in hand for the Russian volunteer fleet, the Japanese Admiralty and Dutch Admiralty. The White Star Line S.S. "Oceanic" is being fitted for the chilled beef trade, and two new ships of the Atlantic Transport Co., for the same; also eight ships for the Hamburg American Steam Packet Co. For the frozen meat trade five steamers to carry 2,000 tons each, of which two ships for Messrs. Tyser & Co., also three ships of the Chargeurs Reunis Co., and two more ships to carry 3,000 tons each. For the importation of butter and bacon from Denmark ships have recently been completed for Thomas Wilson, Sons & Co., United Steamship Co. of Copenhagen. For the Canadian butter and produce trade two ships for J. & A. Allan & Co., are in hand. The Union Steamship Co. have recently had two ships fitted and two more are to follow; also Donald Currie & Co., two ships for importing fruit from the Cape and for preserving the passengers' provisions, etc. Elder, Dempster & Co. also have ordered machines for six ships, and Japanese companies increase the total by six. Machines for land purposes are to be supplied for the Riverside Cold Storage Co., Liverpool, the ultimate capacity of the stores being equal to one million cubic feet of cold storage, half of which is to be started upon at once, and 50 tons of ice per day is to be produced. The Hastings Cold Storage & Ice Co. are also to have a plant completed there by next spring; the Burmah Oil Co. have just ordered a fifth large machine for cooling oil, at their works at Rangoon. There are over 40 on this list of land machines which comprises machines for cold storage, ice making, dairies, breweries, hotels, chocolate cooling, water cooling, etc.

THE MASTER PLUMBERS' ASSOCIATION, MONTREAL.

The Montreal Master Plumbers' Association at their last annual meeting elected the following officers for the ensuing year: Hon.-pres, J. Date; pres., J. Watson; first vice-pres., E. Lesperance; second vice-pres., J. A. Sadler; third vice-pres., Joseph Thibault; sec., N. Lariviere; English cor.-sec., J. W. Hughes; French cor.-sec., J. Lamarch; fin.-sec. J. Montpetit; treas., P. C. Ogilvie. Committees, Sanitary—P. J. Carrol, J. Young, D. Gordon, Jos. Gibeau, N. A. Egan, Arbitration—J. Atcheson, A. Martin, J. Giroux, W. A. Stephenson, R. Egan; Apprenticeship—E. C. Mount, W. J. Graham, H. Brosseau, J. Lafranc, J. Ballantine; Legislative—J. W. Harris, G. Denman, J. C. Brunet, H. Roddon, T. O'Connell. The association will devote a great deal of time to the revision of the plumbing by-laws of the city of Montreal during the year, in the hope that substantial changes in the present regulations may be obtained.

WATER POWER IN THE OTTAWA VALLEY.

There will shortly be published in Ottawa a map showing the water powers available within a radius of 45 miles of the city of Ottawa. An approximate estimate of each power, and leaving out small powers of from 10 to 20 h.p. to be found on every small stream north of the city, aggregates the enormous amount of 890,000 h.p. This is a very conservative estimate, our correspondent writes, based not even on the mean volume of water on each stream, but on a stage between mean and low water. The most important feature of the powers in this district, however, is the fact that the source of supply of each stream rests in large lakes that at small expense for retaining dams can be converted into enormous reservoirs by means of which the powers can be largely increased and regulated during seasons of extreme high and low water. Within 25 miles of Ottawa is the vast water power of the Chats Rapids. It is estimated (from regular survey), at 120,000 h.p., not a pound of it being now utilized. With unlimited supplies of pulpwood, tan bark, furniture wood, mica, phosphate of lime, plumbago, feldspar, iron and workable mines of galena and gold, and the cheapest and easiest controlled power in the world, Ottawa might be said to be almost destitute of manufactures, and many of these valuable powers are lying idle in the hands of speculators. The vast possibilities of the electric furnace; the fact that so enormous a power can be concentrated at Ottawa by means of the dynamo, and a few miles of copper wire is attracting the attention of manufacturers and capitalists in a way that will, in a very few years, make the Canadian capital something more than a political centre.

MILEAGE OF ELECTRIC RAILWAYS IN ONTARIO.

Editor Canadian Engineer :

Can you inform me as to the number of miles of electric railways in operation in Ontario. Trolley.

Toronto, January 21st.

[The total mileage of electric railways in the province of Ontario to December 31st, 1897, was 291 miles. The figures for 1898 are not yet available, but no important additions have been made during the year.—Ed.]

TO SQUARE A SQUARE.

Editor Canadian Engineer :

I am a subscriber to The Canadian Engineer and wish to ask you for the best way to square a carpenter's square. Yours truly, S. Q. R.

[To test the accuracy of a carpenter's square it may be compared with some standard of recognized correctness; as the standards set up by the various governments, or a square by a maker whose reputation for accuracy is established, as Brown & Sharpe, may be used.—Ed.]

ASSOCIATION OF ONTARIO LAND SURVEYORS.

The fourteenth annual meeting of Land Surveyors of Ontario, being the seventh annual meeting since the incorporation of the present association, was held in the rooms set apart for the use of that body in the Parliament Buildings at Toronto on the 28th February, and 1st and 2nd of March. Although, for different reasons several of the regular attendants at the annual meetings were unable to be present on this occasion their places were filled by members from a distance, who enjoyed a rare opportunity of meeting and interchanging ideas with their brethren. Among those present were: A. W. Campbell, H. L. Esten, R. P. Fairbairn, Prof. Jno. Galbraith, K. Gamble, Geo. B. Kirkpatrick, W. A. McLean, C. J. Murphy, Villiers Sankey, Henry Smith, L. B. Stewart, A. J. Van Nostrand, A. P. Walker, A. T. Ward and J. F. Whitson, all of Toronto; Walter Beatty, Delta; Lewis Bolton, Listowel; H. J. Bowman, Berlin; John Davis, Alton; James Dickson, Fenelon Falls; J. D. Evans, Trenton; W. B. Ford, Hamilton; F. L. Foster, Mine Centre; P. S. Gibson, H. H. Gibson and W. S. Gibson of Willowdale; James Hutcheon, Guelph; T. H. Jones, Brantford; Hugh McGrandle, Huntsville; A. J. McPherson, Galt; J. L. Morris, Pembroke; Alexander Niven, Haliburton; J. A. Paterson, Hamilton; John Roger, Mitchell; Geo. Ross, Welland; H. DeQ Sewell, Rat Portage; Angus Smith, Ridgetown; J. W. Tyrrell, Hamilton; W. F. Van Buskirk, Stratford; H. K. Wicksteed, Cobourg, and T. H. Wiggins, Cornwall. During nearly all the sessions the chair was occupied by P. S. Gibson, president of the association, H. J. Bowman, the vice-president, presiding during the remainder of the meeting.

The morning of the first day having been devoted to committee work the general meeting opened at 2 p.m. After an opening address by the president the report of the Council of Management (including the reports of the Board of Examiners and secretary-treasurer), was read by Major Sankey, and the financial statement submitted to A. W. Campbell and H L. Esten, auditors. Reports were also presented by the committees on Publication, Repository and Biography and Polar Research. A paper on "Progress of Gold Mining in the Central Belt of the Rainy River District," prepared by H. W. Selby of Dinorwic, and read by H. DeQuincy Sewell, gave a good description of the work being done in developing the natural resources of that section of the province. A paper by F. L. Foster, who has recently returned from a two years' sojourn in the Seine river region, entitled "Surveying in the Mining Lands of Ontario," described the life led by practitioners in the remote parts of the province, giving some of the advantages and disadvantages to be met with in that style of practice. The chairman of the Committee on Exploration presented the report of that committee, comprising some valuable hints as to work required to be done in that direction.

In the evening a paper prepared by C. Unwin, one of the veterans of the profession, was read by his former partner, H. L. Esten, as illness prevented the attendance of the author. Experiences never to be forgotten were detailed, and recalled to the minds of the older members present lively recollections of hardships endured by each in his earlier battles with the wilderness.

A paper on "Some Incidental Benefits from the Growth of Forests," prepared by Thos. Southworth, clerk of Forestry, was read by J. F. Whitson, as the writer had not yet recovered from the effects of grippe. We will discuss this article more at length in a future issue. L. B. Stewart, lecturer in surveying at the School of Practical Science, Toronto, read a carefully prepared paper on "Azimuths," giving formulae for establishing meridians by observations of stars in the vertical of polaris. There is no doubt that when this method becomes familiar to surveyors engaged in work in which observations are frequently required it will be found to be a great boon. "Explorations" was the subject of a paper by James Dickson, inspector of Crown Land Surveys, and it was treated in an able manner. The prevailing idea that the life of a land surveyor during a season in the woods is a perpetual picnic was held to be erroneous, as shown by the effect on the average young man who tries it with that idea uppermost in his mind. It was suggested that for obtaining necessary information respecting the unsurveyed lands of the province, the Government should cause exploratory lines to be so run as to divide the territory into blocks eighteen miles square, these lines to serve as exterior boundaries for future townships.

The morning session of Wednesday, 1st March, was opened by a paper by James Warren of Walkerton, on "The Calculation of Strains in Bridge Trusses," read, in the unavoidable absence of the writer, by J. L. Morris. It was followed by a paper by A. W. Campbell, provincial instructor in road-making, on "Bridges and Culverts for Highways." Both these papers were well received and discussed by members who engage in municipal engineering work. A short paper on "The Use of the Compass for Railway Surveys," was read by J. D. Evans, who was well supported in his statement that the compass, when properly used possesses great advantages over the transit for preliminary work, as its results in the field are more accurate than the plotting of the work can be, while the time required for running a given distance is very considerably lessened by the use of the former instrument. In the afternoon a paper by A. Niven on "The Survey of the Boundary Line Between Nipissing and Algoma Districts," gave a graphic description of the hitherto almost totally unexplored region traversed by a meridian line from the Canadian Pacific Railway to a point on Moose River, near its outlet into James Bay. Major Sankey, who during the past summer represented the City of Toronto in an exploration survey to determine the feasibility of a railway to that seaport, added some valuable information during the subsequent discussion. Next on the programme came a most interesting paper by Lewis Bolton, entitled "A Trip to Yukon and Return," dispelling the common idea that the hardships to be met with in a journey to the land of untold mineral wealth are such as need deter any man of determination and a moderate degree of vigor from undertaking it.

In the evening the annual dinner of the association was held at McConkey's parlors, and proved a most pleasing relaxation. The toast "Canada" was responded to by Sir Sanford Fleming, whose reminiscences of early days were very warmly welcomed. Aubrey White, assistant commissioner of Crown Lands, responded to "Ontario." "Sister Societies" was spoken to by W. T. Jennings, president Can. Soc. C.E., J. Galbraith and Chas. Rust, city engineer, Toronto; .Kivas Tully responded to "Learned Professions" on behalf of the architects. T. Harry Jones, Brantford, won immense applause by reciting Kipling's poem, "Sergeant What's His Name," which fitted well into the strongly imperialistic sentiments of the gathering.

At the Thursday morning session, 2nd March, the presentation of the report of the Committee on Topographical Survey was made by John Roger in the absence of the chairman, Otto J. Klotz. No actual work has yet been begun in this class of survey, but it is expected that in the near future the Dominion Government will inaugurate this much needed work. Vice-President H. J. Bowman next read a paper on "Open Questions," one of the chief of which was the improvement of highways by means of systematic State aid, following the methods now in vogue in the wealthier States of the Union. The report of the Committee on Drainage with "Question Drawer" was read by the chairman, George Ross, and discussed by the members. A. Niven, chairman of the Committee on Land Surveying, presented the report of that committee with Question Drawer containing problems met with by members in all parts of the province; the opportunity of having an advisory board composed of the most experienced practitioners in the association appearing to have been appreciated by those whose practice included these knotty points. "Drains of Field Tile," was the title of a paper read by Captain W. F. Van Buskirk, dealing with an ever increasing class of work within the practice of the majority of the members, as agriculturalists become more convinced that drains, to be effective, must be scientifically constructed.

Afternoon Session.—T. H. Wiggins read a paper descriptive of the "Payne River Drainage Scheme" thus adding a considerable amount of valuable information to the collection already appearing in the annual reports of the association, and from which the work of formulating schemes for the reclamation of waste lands and estimating the probable cost will be greatly diminished. The report of the committee, composed of V. Sankey, G. B. Kirkpatrick and A. Niven, specially appointed last year for the purpose of taking cognizance of any legislation affecting Ontario land surveyors, was presented by V. Sankey, and a bill for the incorporation of the Canadian Society of Civil Engineers in Ontario, was discussed at length. The committee was continued in office with the addition of H. K. Wicksteed and J. L. Morris to its numbers. The president read a circular from the Ontario Historical Society explaining the objects of the exhibition to be held, and bespeaking the co-operation of the members of the association.

Owing to lack of time the following papers and reports were, upon motion, ordered to be taken as read and printed in the Proceedings, viz.: "Permanent Way," by W. E. McMullen; "Our Professional Standing," by B. J. Saunders; "Perche Drain Dredging Work," by J. H. Jones; "Dominion Lands Surveys," by C. F. Aylesworth, jr.; "A Suggested Amendment to the Ditches and Watercourses Act," by Geo. Smith, and the reports of the committees on Engineering and Entertainment. A resolution was passed conveying the sympathy of the association to the families of the following members whose deaths had been reported since the date of the last annual meeting; Jos. DeGursc, Albert Fowlie, Thos. B. Gilliland, T. R. Hewson, Sherman M. Malcolm, J. H. Ogilvie and James A Macmillan. The secretary was instructed to address letters to Jos. Kirk, M. C. Schofield, F. H. Lynch-Staunton and C. Unwin, expressing regret that they had been unable to be present at the meeting and conveying the good wishes of the members in attendance.

In the nominations of officers for the association year 1899-1900 H. J. Bowman, of Berlin, was elected president; F. L. Foster, Mine Centre, vice-president; A. J. Van Nostrand, secretary-treasurer, and A. W. Campbell and H. L. Esten, auditors, all without contest. F. L. Foster having resigned his position as member of council the following candidates were nominated for the three vacancies on the Council of Management, viz., James Dickson, Fenelon Falls; H. K. Wicksteed, Cobourg; W. F. Van Buskirk, Stratford; A. Niven, Haliburton; G. B. Kirkpatrick, Toronto; Jas. Hutcheon, Guelph; Jno. Davis, Alton; A. P. Walker, Toronto, and George Ross, Welland. The voting will be by letter ballots, which will be opened by the secretary-treasurer in the presence of Captain Gamble and J. F. Whitson, scrutineers, on Thursday, April 6. After votes of thanks had been tendered the retiring president and chairman of the council, and graceful acknowledgments returned, the meeting, one of the most interesting yet held, was closed with "God Save the Queen."

—John Burns, the English labor leader, has a forcible article in the Co-operative Wholesale Annual on the risks and casualties of labor. He estimates the number of industrial accidents every year in the United Kingdom at 400,000—which is probably somewhat below the mark. He points out that a thousand miners are killed every year, that 1,334 British sailors were lost at sea last year, that more men were killed in making the Barry Dock than at Balaclava, and that more workmen are killed and injured every week in London alone than in the recent Egyptian campaign.

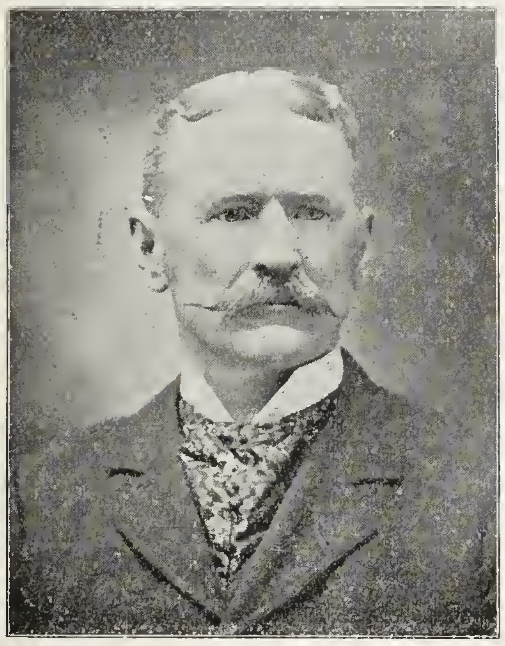
THE CANADIAN MINING INSTITUTE.

The Canadian Mining Institute held its annual general meeting at the Windsor Hotel, Montreal, March 1st, 2nd and 3rd, when the following papers were read: On Mine Costs; by John E. Hardman, S.B., Montreal; Swedish Iron Metallurgy and its application in Canada, by Dr. James Douglas (president American Institute of Mining Engineers), New York; on the Sampling of Argentiferous and Auriferous Copper, by Dr. A. R. Ledoux (vice-president American Institute of Mining Engineers), New York; on the West Kootenay Ore Bodies, by Messrs. R. G. McConnell and R. W. Brock, Ottawa; Explorations for Iron Ore in Newfoundland and Cape Breton, by C. A. Meissner, Londonderry, N.S.; Notes upon the Development of the Iron Ore Industry, by John Birkinbine, M.E., Philadelphia; on Hydraulic Mining, by John B. Hobson, M.E., Quesnelle Forks, B.C.; some notes on Prospecting for Wolframite or Tungsten in Cape Breton, by C. A. Meissner, Londonderry, N.S.; An Improved Method of Feeding Water to the Stamp Mill Mortar, by Bernard MacDonald, M.E., Montreal; on Hydraulic Elevators for Gold Gravels, by James Champion, C. & M.E., Barkerville, B.C.; on the Gold Measures of Nova Scotia and Deep Mining, by E. R. Faribault, Ottawa; Across the Pitch versus Up the Pitch, by O. E. S. Whiteside, Ba. Sc., M.E., Anthracite, N.W.T.; the Designing of Metallurgical Machinery, by A. C. McCallum, Peterboro, Ont.; the Adjustments and Control of the Stamp Mill, by Prof. De Kalb, Kingston, Ont.; on the Occurrence of Cinnabar in British Columbia, by A. J. Colquhoun, M.E., Savonas, B.C.; on the Establishment of Science Classes in Mining Centres, by A. H. Holdich, Nelson, B.C.; on Metallurgical Standards, by F. T. Snyder, Vancouver, B.C.; on the Occurrence of Free Milling Gold Veins in British Columbia, by W. Hamilton Merritt, Toronto; Electrical Transmission and Electric Drills, by F. Hille, M.E., Port Arthur; Smelting Conditions in British Columbia, by R. C. Campbell Johnstone, M.E., Nelson, B.C.; A New Device for Thawing Dynamite, by Daniel Smith, Kingston, Ont.; on Acetylene as a Mine Illuminant, by Andrew Holland, Ottawa; A Review of the Canadian Iron Industry in 1898, by George E. Drummond, Montreal; Description of the Sultana Quartz Lode and the Sinking of the Burley Shaft on Bald Indian Bay, by J. Burley Smith, M.E., Winnipeg; on the Lillooet Gold District, B.C., by F. Cirkel, M.E., Vancouver, B.C.; on Palaeontology in its Relation to Mining, by Dr. Henry M. Ami, Ottawa; on the Gold Bearing Sands of the Vermilion river, by J. W. Evans, C. & M.E., Trenton, Ont.; Notes on the Driving of the Simplon Tunnel (Swiss Alps), by Leopold Meyer, M.E., Ottawa; Notes on Mining in Quebec, by J. Obalski, M.E., Quebec; A Notable Canadian Deposit of Chromite, by J. T. Donald, M.A., Montreal; on the Petrographical Character of the Ore from the Republic Camp, by Dr. Frank D. Adams, Montreal.

The following subjects illustrated by lantern projections, were also presented: The Designing of Metallurgical Machinery, by A. C. McCallum, Peterborough; Prominent Mines and Smelting Works of the Dominion, by Dr. Geo. M. Dawson, C.M.G., Ottawa; View of Work on the Chicago Drainage Canal, by James F. Lewis, Chicago.

The fact that the meeting was in progress as this issue of The Canadian Engineer was going to press makes it impossible to give a satisfactory report of the convention in this issue, and we shall return to the subject next month and discuss some of the papers quite fully. The following were the officers elected: President, John Hardman, S.B.M.E., Montreal; vice-presidents, Messrs. W. A. Carlyle, Rossland, B.C.; Dr. George M. Dawson, C.M.G., Ottawa; Hiram Donkin, Glace Bay, Cape Breton and George E. Drummond, Montreal; secretary, B. T. A. Bell, Ottawa; treasurer, A. W. Stevenson, C.A., Montreal; council, E. T. Galt, Lethbridge, N.W.T.; S. S, Fowler, Nelson, B.C.; Robert R. Hedley, Nelson, B.C.; Wm. Blakemore, Coal Creek, B.C.; C. A. Meissner, Londonderry, N.S.; J. R. Cowans, Springhill, N.S.; Wilbur L. Libbey, N. Bookfield, N.S.; Clarence H. Dimock, Windsor, N.S.; George R. Smith, M.L.A., Thetford Mines, Que.; J. Obalski, Quebec; Dr. Frank A. Adams, Montreal; R. T. Hopper, Montreal; James McArthur, Sudbury, Ont.; A. Blue, Toronto; Chas. Brent, Rat Portage, Ont., and Eugene Coste, Toronto.

A. E. WILMOT, MEM. CAN. SOC. C. E.



A. E. WILMOT.

The portrait and biographical sketch of A. E. Wilmot was received too late to appear in the February issue of The Canadian Engineer along with the other new officers of the Canadian Society of Civil Engineers, to whose council Mr. Wilmot was elected at the last meeting. In 1868 Mr. Wilmot was assistant engineer on Eastern Extension Railway (now part of the Intercolonial Railway), between Painsac Junction on the St. John and Shediac Railway, and Amherst, N.S. From 1869 to 1874 he was assistant engineer on the survey and construction of the Intercolonial Railway, Miramichi district, and in 1874 to 1876 had charge of a division on the construction of the M.N.C. Railway between Montreal and Ottawa. In 1876 to 1879 he was employed on construction of Canada Central between Renfrew and Pembroke, and on surveys of C.P.R. 1879 to 1881 had charge of a division of 40 miles on construction of the C.P.R. west of English river. In 1881 to 1884 Mr. Wilmot made final location, and had charge of construction of 30 miles of C.P.R. between Harrison river and Yale, B.C., and in 1884 to 1886 he was engaged by the Dominion Government on survey on railway belt from Port Moody, 180 miles easterly, and by Provincial Government of British Columbia on township surveys on Vancouver Island. He was employed in 1887 to 1888 on construction of C.P.R. short line between St. Johns and Sherbrooke, Que., and in 1888 to 1890 was engaged in private practice in British Columbia, including survey on New Westminster and Southern Railway for a water supply for New Westminster city, and survey of town sites in New Westminster and Nelson districts. From 1890 to 1892 Mr. Wilmot was resident engineer on construction of a sewage system for Victoria, B.C., and from 1892 to the present time, city engineer for Victoria, B.C.

The superintendent of the Montreal waterworks wants $210,000 to spend on repairs to turbines, reservoirs, inspection of mains and new services.

THE BRITISH FIRE PREVENTION COMMITTEE.

The British Fire Prevention Committee, under whose auspices a testing station was opened at 35 North Bank, Regents Park, London, Eng., January 31st, was founded after the Cripplegate fire of November, 1897, and will now shortly see its full incorporation. It counts a membership of some five hundred architects, surveyors, engineers, municipal officers and others directly or indirectly interested in fire prevention, among whom are practically all the leading members of the profession named. The offices are at No. 1 Waterloo Place, where the library includes a file of some fifty technical journals from all parts of the world, and the regulations and building acts, etc., of all countries. Regular publications are issued by the committee (twelve already having appeared), and meetings are frequently held. The founder was Edwin O. Sachs, architect. Three of the primary objects of the committee are defined as follows: To direct attention to the urgent need for increased protection of life and property from fire by the adoption of preventive measures. To use its influence in every direction towards minimizing the possibilities and dangers of fire. To undertake such independent investigations and tests of materials, methods and appliances as may be considered advisable.

It is with the idea of meeting these objects that a testing station has been established.

The purpose of the tests is to obtain reliable data as to the exact fire-resistance of the various materials, systems of construction, or appliances used in building practice. Such data have not as yet been available, owing to the fact that nearly all investigations of this description have been carried out by individual makers, or inventors with specific commercial objects in view. The present tests will be of an entirely independent character, arranged on scientific lines, but with full consideration for the practical purpose in view. Absolute reliability will be assured, records being mostly taken automatically, or by photography, and the temperatures being easily regulated by the application of gas. All reports on tests will solely state the bare facts and occurrences, with tables, diagrams and illustrations.

The general arrangement and direction of the tests will be in the hands of the executive, and in accordance with certain principles laid down after careful study and experiment. The actual tests will be attended by the members of the council and the members of the committee in rotation, care being taken that the attendance is always thoroughly representative of the technical professions primarily interested in the specific object under investigation.

LITERARY NOTES

The Marine Review, Cleveland, O., U.S.A., has made an enlargement of four pages and will publish an issue of 30 pages in future.

The Geological Survey of Canada has recently issued Part S. Annual Report, Vol. X., being the section of mineral statistics and mines of the annual report for 1897. It bears on the cover the names of E. D. Ingall, M.E., and Theo. C. Denis, B.Sc., and J. McLeish, B.A.

By the amalgamation of The Electrical World with another electrical publication W. J. Johnston has retired from active journalism in the electrical field. Though a young man, Mr. Johnston is the father of electrical journalism, as he founded the first paper devoted to electricity. It was for many years published in the interest of telegraphers.

The Royal Electric Co. has just issued a very neat desk memorandum book, which contains in addition to blank spaces for memoranda a vast amount of condensed information of interest to all users of electricity. The tables are exceeding useful. The same company has also sent out a pad calendar, which bears the dates and the praises of the apparatus supplied by the Royal Electric Co.

We have just received from the publishers a copy of a beautiful Religious Reverie, called "Holy Angels" suitable for piano or organ, composed by George D. Wilson. The retail price of this piece of music is 60 cents. All readers of this journal will receive a copy of it, by sending 25 cents in silver, or postage stamps (Canadian or American), to the Union Mutual Music and Novelty Co., No. 20 East 14th street, New York.

H. F. J. Porter, of the Bethlehem Iron Company, lectured to a large audience at the 521st meeting of the Society of Arts, Massachusetts Institute of Technology, recently. His subject was "Modern Forging," and he presented in a very interesting way, with numerous illustrations by the stereopticon, the methods in vogue at the Bethlehem works of forging such articles as hollow and solid shafts, dynamo field rings, guns and armor plate. Defects in the old methods of forging and the steps leading to the present methods were well explained.

We cannot too highly commend the work done by the Thorold and Beaver Dams Historical Society in giving to the public such a comprehensive record of the events which have made that quarter of the Niagara peninsula the Peloponnesus of Canada. The heroic tramp of Laura Secord, 19 miles through a snake-infested woods to warn Lieut. Fitzgibbon of the enemy's approach, the capture of the whole American force by a handful of British as a result of this warning, and many other deeds of daring during the war of 1812, are recounted here, while the less dramatic but equally heroic achievements of peace—the tedious assaults on the primeval forests, the transformation of the woods into wheat fields and of the marshes into gardens—are recorded with a faithful pen. Nor is the industrial and social progress of the township and town overlooked, many instructive bits of history and biography being scattered through the 289 pages of the volume. In fact it is only by the light of such work that the real history of the Canada that is yet to be can be compiled. Much interesting information is given about the Welland canal. The family of Keefer, of whom Thos. C. Keefer, C. H. Keefer and others have been so prominent in the engineering annals of the country, are found among the many sturdy early settlers. The pre-factory days, when the spinning-wheel and the hand-loom were in evidence and the stage coach and ox-wagon were the only means of transport, are truthfully sketched, while the record of the first mills and industrial establishments is very instructive. It is interesting to find, for instance, that Thorold had in 1847 what was undoubtedly the first cotton mill in Ontario, though not the first in Canada, as alleged, for a cotton mill existed in Sherbrooke in 1844, and it is equally worthy of record that this town had the first regular electric railway in Canada, the Thorold and St. Catharines line having been opened on the 5th October, 1887. Taken altogether, the Jubilee History of Thorold is a model of its kind, and is eminently creditable to John H. Thompson, the compiler, and to The Thorold Post Printing and Publishing Co., whose establishment did both the printing and binding.

Industrial Notes.

Lesperance & Theriault, plumbers, Montreal, have dissolved partnership.

Ronald McDonald will establish a machine shop, it is said, in Pictou, N.S.

Edward J. O'Brien has registered as proprietor of the Peoples Plumbing Co., Montreal.

The Bennet Furnishing Co., London, Ont., is about to install a Leonard Engine of the self-oiling type.

T. Dexter, of Sebringville, Ont., has bought the North Branch flour mills, London, Ont., formerly owned by Robb Bros.

Gananoque, Ont., is applying to the legislature for permission to make a loan to Wm. McKenzie to establish a furniture factory.

The Sarnia, Ont., Salt Co. is building a dock, warehouse, etc., and will very shortly be turning out salt and other products.

The Dominion Government has closed a contract for 40,000 bags of cement from the United States at $2.20 per barrel, laid down in Montreal.

There is an amendment to the Ontario Municipal Act which is aimed at the bonus evil. By it only cases of loss by fire are fit subjects for aid from a bonus and then only when a two-thirds vote of the ratepayers qualified to vote has been obtained.

The Iron Manufacturers' Association of Canada met recently in Montreal and advanced prices on manufactured goods owing to a rise in iron prices.

The lumber mill of C. T. White, Apple River, N.S., which was destroyed last spring, will be rebuilt it is understood during the present winter.

The Nova Scotia Pork Packing Co., Middleton, N.S., has employed F. F. Judd, Boston, U.S.A., to supply the plans, superintend the construction of the building and the installing of the machinery.

The very novel and suggestive advertisement of the Penberthy automatic injector on another page conveys very clearly the idea that an ocean of water is supplied to steam boilers all over the world by the Penberthy injectors.

A. L. Davis, W. J. R. Sims, J. R. Stratton, W. G. Morrow and A. A. Cox, Peterborough, Ont., are applying for incorporation as the Trent Valley Peat Fuel Company, Ltd., to manufacture peat for fuel purposes; capital, $5,000; chief place of business, Peterborough.

During the recent elections in New Brunswick a great deal of discussion centred on the bridge contracts which had been carried out by the Record Foundry Co., Moncton, at 6½ cents per lb., at the works. The Dominion Bridge Co. quotes 2.65 to 3 cents per lb. for similar work.

An Ontario charter has been granted to S. A. King, M.D., and O. E. Fleming, Windsor, Ont.; C. M. Walker, W. C. Kennedy, Walkerville, Ont., and J. H. Brown, of Rural Retreat, U.S.A., as the Diamond Harrow Company of Windsor, Ltd., to manufacture agricultural implements; capital, $30,000.

T. Simms & Co., of St. John, who recently purchased the old saw mill, spool and box factory on the German Brook, Hardington, N.B., together with 700 acres of woodland, formerly owned and operated by L. P. Hayden, are putting machinery in the spool and box factory to make brushes.

An interesting folder has reached us from the J. Stevens Arms & Tool Co., Chicopee Falls, Mass., U.S.A., which gives details of the Stevens rifles, of which some new features of great value are the new model pocket or bicycle rifle, and the ideal sporting and hunting rifle, which is very low priced, but accurate in aim, and fully guaranteed by the company.

The boiler in R. O. Konkle's sawmill, Beamsville, Ont., exploded February 18th, causing damage to property in the vicinity. The engineer had just left the boiler room and was unhurt. John Konkle, son of the owner, was injured. The mill building was demolished, and the trees for five hundred yards were damaged, the boiler being thrown that far.

James Wright, of the wholesale and retail hardware firm of James Wright & Co., London, died a short time ago. Mr. Wright, who was one of London's oldest business men, came to Canada in 1858, and after teaching school six years, commenced business in partnership with James Cowan. On the dissolution of that partnership, he went into the wholesale trade, in which he was very successful. From his first settlement in London he took an active part in everything tending to the substantial growth of the city, and was for twenty years a member of the school board.

We have seen plans of the proposed alterations to the Toronto premises of the Union Bank of Canada. When completed, the building will be nearly as wide again as at present, and the front will be on the street line. The banking offices will be inside the easterly entrance, while a new doorway will be placed at the west front. It is intended that the offices other than those for the bank's use, shall be fitted up in a modern manner for general business purposes. The whole effect of the reconstruction will be very fine. Bond & Smith, architects, Temple Building, Toronto, are the architects.

An amendment to the Municipal Act now before the Ontario legislature provides that the corporation shall have power to supply water upon special terms to any corporation or person, whether resident without or within the municipality, including powers to construct, erect and maintain all pipes and mains requisite for the undertaking and for conveying and distributing water to such corporation or person in, upon and through any highway lying between any of their reservoirs, waterworks, pipes and mains and the lands or premises of the corporation or person to be supplied with water.

J. Watson, Kingsbury, N.S., is building a cheese factory near Danby.

The Brantford, Ont., Board of Trade are working for a technical school in that progressive town.

Hespeler, Ont., is anxious to sell W. A. Kribs a site in the park for a box factory, at a nominal figure.

The Robb Engineering Co., Amherst, N.S., has received an order from J. E. & G. Lake, Fortune Bay, Nfld., for a 40 h.p. engine and boiler.

D. G. and F. Loomis, Sherbrooke, Que., are buying new machinery to fit up their new wood-working shops in the Gas and Water Co.'s building.

The jail, Toronto, requires a new 70 h.p. boiler, as the Boiler Inspector has condemned the present one as too small for the present service required.

McKay Bros., East Hatley, are putting in one of the Jenckes Machine Co.'s steam plants, consisting of a slide valve engine and horizontal tubular boiler.

The farmers at Fort Saskatchewan, N.W.T., are organizing a company to build a flour mill; $30,000 stock has been subscribed. The secretary is W. Griesbach.

Halifax, N. S., will grant exemption from all taxes to new industries investing at least $10,000, except a tax of 1 per cent. on the value of the real estate occupied.

Thomas Lord, of L'Epiphanie Station, Que., is increasing his plant by the addition of a 35 h.p. engine from the well-known builders, the Jenckes Machine Co., Sherbrooke, Que.

The MacGregor-Gourlay Co., Galt, Ont., has a rapidly increasing export trade. One of the firm's largest wood working machines has just been shipped to Glasgow, Scotland.

Macphee and Meader, of Moulinette, Ont., propose to build a $10,000 flour mill of a 100 barrel capacity at South Finch, Ont. They will ask for a site, exemption from taxation and a cash bonus,

The Owen Sound, Ont., Iron Works Co., Ltd., has been granted Ontario letters patent; capital, $20,000. The incorporators are J. M. Wilson and Margaret Wilson, George Menzies and Lora Menzies, and Edward Todd.

A sawmill is being built at Springhill, York Co., N.B., by John Campbell, jr. He has ordered a 100 h.p. engine and boiler, and other machinery, from the Robb Engineering Co., Amherst, N.S.

David Ouellet, architect, Montreal, is preparing plans and specifications for a new wing to be added to the seminary of Rimouski, and also for the extension of the College at St. Anne de la Pocatiere, Que.

Geo. Long, Sherbrooke, Que., whose increasing woodworking business requires more motive power, is about to instal a 25-inch Crocker turbine, in order that production may cope with the demand. The order was placed with the Jenckes Machine Co.

An Ontario charter has been granted to W. J. McMurtry and W. T. Eagen, Lillian L. McMurtry, T. C. Harding and F. C. Cooke, Toronto, as the Gold Medal Furniture Manufacturing Co., Ltd.; capital, $100,000; to carry on the business of W. J. McMurtry.

At the annual meeting of the Montreal Rolling Mills Co., after the presentation of a satisfactory statement for the year, the following directors were elected: Andrew Allan, president; Hugh McLennan, vice-president; Hon. G. A. Drummond, E. S. Clouston, Wm. McMaster, Henry Archbald and H. M. Allan.

A test was made in Montreal recently of a fire-proof coating for ceilings, etc., called Salamander, by the American Fireproofing Co., Boston. The test is said to have been very successful, and a double wooden floor with Salamander interfilling withstood a hot fire for an hour. This material is said to have been in use in Boston for about sixteen years.

Judgment was given in the Exchequer Court, Ottawa, March 1st. in the cases of the Wellsbach Incandescent Gas Light Company, the Auer Incandescent Light Company, and the Manitoba Auer Light Company v. Anderson, finding that there has been an infringement of the patent. An injunction is issued, and the defendants are ordered to give up all stock made under the infringement.

Windsor, N. S., will buy a steam fire engine to cost about $5,000.

Incorporation is being sought for a company to take over the business of Rhodes, Curry & Co., Amherst, N.S.

The directors of the Toronto Cold Storage Co. are: Thos. Long, president; H. M. Pellatt, vice-president; Wm. McKenzie, Fred. Nicholls and A. E. Ames.

Last year the Hamilton, Ont., sewage disposal works handled sewage at one outfall at a cost of $9.65 per million gallons, and at another, $14.75 per million gallons.

Secord & Quackenbush, Niagara Falls, N.Y., will, it is said, move the Chippewa, Ont., flour mill to Niagara Falls, Ont., and enlarge it to a capacity of 200 barrels per day.

F. Maundrell, A. Leishman, F. Minns and A. L. Schram, Woodstock, Ont., and A. Elliot, Toronto, are applying for incorporation as the Woodstock Metal Working Company, Ltd.; capital, $5,000.

E. Wallace, T. Ahearn, W. Y. Soper, R. Quain and R. W. Shannon, Ottawa, have been incorporated as the Ottawa Building Company, Ltd., capital, $200,000. The company will do a building and loan business.

The North American Fence Supply Co. is applying for incorporation; capital, $40,000. The incorporators are: A. H. Cook, A. Hood, Markham, Ont., A. Hood, Toronto, W. Chester, J. Hall, T. Hood, W. McCowan, T. Britton, township of Scarboro, Ont.

J. C. Walker, E. J. C. Walker, W. Bell, Isabella M. Bell and W. J. Bell, Guelph, have been incorporated as the Electric Boiler Compound Co., Ltd.; capital, $15,000. The company will deal in engine supplies generally and in Walker's Electric Boiler Compound.

F. A. Hilton, C. J. R. Stirling, J. H. Thompson and E. B. Freeland, Toronto, John G. Bowes and T. W. Lester, Hamilton, Ont., have been incorporated as the Voelker Light Company of Toronto, Ltd., to deal in devices for illuminating and heating; capital, $40,000.

Hon. George A. Cox, E. Gurney, E. B. Ryckman, Richard Garland, of Toronto, and W. Y. Soper, of Ottawa, have bought out the entire American interests of the Dunlop Tire Company. The company has been incorporated under a Dominion charter, with a capital of $500,000. The American and Canadian businesses will be conducted separately.

W. P. McNeil & Co., of New Glasgow, are reported as being very busy on a lot of bridge work for the Provincial Government, in the Industrial Advocate, Halifax, N.S. They have recently placed in position a 15 h.p. horizontal engine from the workshops of the I. Matheson Co., which will be used to operate a Sturtevant blower in the foundry of the establishment.

We see by the Hamilton, Ont., papers that the Greening Wire Co. has in contemplation additions to its buildings and improvements to its manufacturing facilities, and has asked the city council to fix its assessment for the next ten years. We are pleased to see the prosperity of its business warrants the Greening Wire Co. in further enlarging its premises.

R. G. Reid & Sons have formed a large company, under the name of the Newfoundland Bleached Pulp Company, with a capital of two million dollars. The scheme also includes the formation of the Newfoundland Pyrites Company, with a capital of one million five hundred thousand dollars. Mills are to be erected at Grand Lake, Newfoundland. Another important venture under the immediate direction of this firm, is the Western Newfoundland Oil Company, which has recently purchased two extensive oil plants, which will shortly be in operation.

At the inaugural meeting of the Toronto Technical School Board, held last month, A. F. Wickson and Charles March were elected chairman and vice-chairman, respectively, and the following committees were struck: School Management—D. J. O'Donoghue, Prof. Galbraith, Robert Glockling, A. M. Wickens, W. A. Langton; property, F. B. Polson, Chas. March, John Tweed, Ald. Crane, Ald. Hallam; finance, Ald. Hallam, Ald. Sheppard, W. J. Wilson, P. T. Trowern, Dr. Orr; printing and supplies, Robert Glockling, D. J. O'Donoghue, Ald. J. J. Graham, W. J. Wilson, W. A. Langton. The financial statement gave the receipts for the year as $12,098.87, and the expenditure $12,181.22, leaving a deficit of $81.22.

H. J. Johnston, R. C. Miller, D. Ogilvy, J. W. Harris, T. A. Morison, A. Collyer and W. J. McGee, Montreal, are applying for a charter as the Diamond Light and Heating Company of Canada, to manufacture and deal in lamps, stoves, etc., which burn petroleum and other illuminating oils; capital, $200,000; chief place of business, Montreal.

R. MacKay, J. Beattie, H. Paton, D. Macmaster, Montreal, and C. MacKenzie, Toronto, are applying for incorporation as the Shedden Forwarding Co., Ltd., to transfer freight and luggage and produce, which is also to be held in cold storage by the company. The chief place of business, Montreal; capital, $700.000.

The Willson Carbide Works Co., of St. Catharines, Ont., will build new works on a very large scale as soon as a suitable power location can be obtained, but the Merritton plant will not be closed, but operated, as at present. The extension is due to the fact that the present works cannot keep up with the rapidly growing demand.

Geo. F. Baird, James Manchester, Joseph Allison, Thos. H. Bullock, D. J. Purdy, Jas. F. Robertson, R. C. Elkin and A. H. Hanington have applied for incorporation as the Portland Rolling Mills, Ltd., with a capital of $90,000 in $100 shares, to carry on the business hitherto conducted on the Strait Shore by the James Harris Co., Ltd.

The Alberta Irrigation Company, of which E. T. Galt of Lethbridge, N.W.T., is president, has commenced work on a mammoth scheme to reclaim lands between Cardston and Lethbridge, in South Alberta. Sixty miles of canals will be built. The sum of $500,000 will be expended, and 500,000 acres of lands irrigated. The main canal is to be finished next year, and the laterals in the following season. It is proposed to sell the lands on low terms, the settlement of the district being of primary importance.

A gas explosion at the Goodison Implement Works, Sarnia, recently did considerable damage to the company's property. In the blacksmith shops the forges are blown by patent blowers. Shortly after the fires had been started the machinery was stopped to adjust a pulley. During the temporary shut down the fires burned low and a quantity of gas accumulated, so much so that when the machinery started and the blowers were put in operation a terrific explosion took place. Fortunately no one was hurt, but the windows of the shop—sashes and all—were blown out by the force of the explosion.

At a general meeting of the shareholders of the Abbott Mitchell Rolling Mills Company, Belleville, Ont., held for the purpose of completing the organization, the following were elected directors: C. Bard, banker, Norwich, Conn.; John Mitchell, banker, of Norwich; Frank A. Mitchell, foundryman, of Norwich, president and managing director; Wm. Abbott, foundryman, of Montreal, vice-president and secretary; Henry Pringle, manufacturer, Belleville, treasurer; and S. S. Lazier, of Belleville. Considerable time was spent in the drafting of by-laws and regulations relating to the company and works. The plans for the buildings, etc., are all completed and in the hands of the engineers, and it is the intention of the company to start work as soon as possible.

A number of Canadian manufacturers met recently in Toronto at the Board of Trade to consider the situation in respect to the Standard Oil Company not being able to supply manufacturers with fuel oil. There were present: A. E. Kemp, chairman; W. A. Kemp, of the Kemp Manufacturing Co; E. R. Thomas, of the Lozier Bicycle Company; George E. Evans, of the Dominion Bridge Company; J. B. Muir, of the Ingersoll Packing Company; R. H. Verity, of the Verity Plow Works, Brantford; Clarkson Jones, of the D. F. Jones Company, Gananoque; J. K. Osborne, of the Massey-Harris Company; G. Gillies, of Gillies & Co., Gananoque, etc. A thorough discussion took place, in which it was shown that in fuel oil, 2½ cents per imperial gallon should be taken off, to enable anti-trust producers to compete with the trust now controlling the Canadian market. A deputation was appointed to wait upon the Government in the matter.

The Beaver Portland Cement Company was recently incorporated with a capital of $150,000, to manufacture Portland cement in Canada with works at Dry Lake, near Marlbank, Ont. It will be under the management of Wm. G. Hartranft, Philadelphia, and the mills will turn out 600 barrels per day. The president is James Dobson, of the carpet manufacturing firm of John and James Dobson, Philadelphia; the vice-president, R. Peverly, president of the Commercial Wood and Cement Co., New York and Philadelphia; R. T. Hopper, Montreal, is the managing director and treasurer of the company. The Commercial Wood and Cement Co. has been appointed sale agent for this company's cement, and their offices will be located in the Canada Life Building, Montreal, under the management of J. F. Twamley. The head offices of the Beaver Portland Cement Co. will also be in the same place.

R. H. Griffin, president of the City Bank, Buffalo; the Hon. T. G. Smith, Buffalo; George Gudewill, New York; A. F. Gault, George E. Drummond, Thomas J. Drummond and James T. McCall, of Montreal, have organized the Canada Iron Furnace Co., Ltd., of which Geo. E. Drummond is managing director, to establish a smelting plant at Midland, Ont. The town will grant a bonus of $50,000. The company guarantee a minimum output of 60 tons of charcoal pig-iron per day. The work would be carried on at least 200 days in the year with an output of not less than 18,000 tons per annum; it also guarantees to employ an average of 70 men directly at works in connection with the smelting and other necessary operations, and further, an additional 130 men in connection with the tributary general operations of the company.

A. Green's fuel economizer was placed in the main pumping station of the Toronto waterworks some time ago. The apparatus was to stand on its merits, and now the engineer in charge of the pumping plant reports that it has effected a great saving in one test, 12.65 per cent., and the assistant city engineer, who has control of the waterworks system, states that the true saving is very small, and in some instances a loss has occurred. Comparing the years 1896 and 1898 Mr. Fellows computes an actual loss of 3 6-10 per cent., rather than a gain, by using the economizer. Under favorable conditions, he admits, the apparatus may be fuel-saving, but these conditions do not obtain, he says, at the pumping station. He therefore does not recommend its acceptance. The public will wait with interest for the settlement of the matter.

A bill now before the Nova Scotia legislature will incorporate the Dominion Steel and Iron Co. Its capital is fixed at $10,000,000, with power to increase to $20,000,000. Before the company can commence operations it must have $1,000,000 of its capital subscribed, and 25 per cent. of this paid up. The men who are in this new company are practically the same as those who compose the Dominion Coal Company. At the head of the list of incorporators is Henry M. Whitney, of Boston; H. F. Dimock, of New York; Almeric Page, of New York; and W. B. Ross and B. F. Pearson, of Halifax. The charter gives the company almost unlimited power in carrying on iron manufacturing operations. They have already bonded extensive iron areas in Belle Isle, Newfoundland, for $1,000,000, and it is their intention to erect blast furnaces and smelting works in Cape Breton. Muggah's Creek, C. B., has been spoken of in connection with the establishment of the works. The iron areas at Belle Isle, for which $1,000,000 will be paid to the Nova Scotia Steel and Iron Company, who now own them, are estimated to contain 30,000,000 tons of ore.

The manufacturers of Montreal are up in arms against the proposal to tax machinery and manufacturing plants generally. A vigorous protest has been sent in to the Quebec legislature signed by the following, among others: John McDougall, The Shearer & Brown Co., The James Shearer Co., Consumers' Cordage Co., Ltd.; Canada Switch & Spring Co., Ltd.; The Singer Manufacturing Co., The Montreal Rolling Mills Co., The Thos. Davidson Mnfg. Co., Ltd.; The J. C. McLaren Belting Co., Dominion Wadding Company, The Bishop Engraving and Printing Co., The Sunlight Gas Company, Ltd.; John Date, Thos. Robertson & Co., Ltd.; McFarlane, Son & Hodgson, Gazette Printing Co., Montreal Lithographing Co., W. W. Ogilvie, Montreal Horse Nail Co., Pillow & Hersey Mnfg. Co., B. J. Coghlin, The Canada Sugar Refining Co., The James Cooper Mnfg. Co., J. & T. Bell, The James Robertson Co., Ltd.; F. Tremblay, The Canada Paint Co., Ltd.; The Canada Machinery Agency, Graham & Co., Wm. Clapperton & Co., R. H. Buchanan & Co., Thompson Shoe Co., J .C. Wilson & Co., Major Manufacturing Co., Ltd.; Canada Paper Co., Collyer & Brock, Belding, Paul & Co., Phillips Electrical Co.

Electric Flashes.

A project is going forward to light St. George, Ont., with electricity.

The Maritime Electrical Association will hold a convention about April 18th in Halifax, N.S.

The British Columbia Electrical Supply Co. is applying for incorporation to do business in Rossland, B.C.

H. D. Symmes of St. Catharines has recently installed one of the Royal Electric Company's 35 light, four pole, direct current dynamos.

The Port Perry Electric Light & Power Co. has given the Royal Electric Company an order for a 2½ k.w. four pole exciter, to replace the exciter at present installed there.

S. W. Bradley, Aylmer, Que., formerly one of the chief officials of the Hull Electric Railway, has been appointed manager of the Cornwall, Ont., Electric Street Railway.

A. W. Hepburn, Picton, Ont., is fitting out his steamer with electricity. The order for a 12½ k.w. generator has been placed with the Royal Electric Co., to be installed at once.

The McPherson Shoe Company of Hamilton are installing in their works one of the Royal Electric Company's 50 h.p. "S.K.C." two-phase motors. This is to replace the present steam plant.

The Eclipse Whitewear Company of Toronto, has been changing its motive power and increasing its factory. It has placed an order with the Royal Electric Company for a 10 k.w. four pole 250 volt motor.

John Forman, 644 Craig street, Montreal, announces a very interesting catalogue which should be in the hands of everyone interested in electrical supplies. When writing to ask for it mention The Canadian Engineer.

The C. O'Dell Electric Co. of Annapolis, N.S., recently placed in position a 120 h.p. Leonard-Ball automatic engine, which, together with a new boiler, will permit them to double the producing capacity of the plant.

Brown & Boggs, Hamilton, Ont., have decided to operate their factory by electric power, and are installing a 30 h.p. two-phase "S.K.C." motor. Power for the same being furnished by the Cataract Power Co., Hamilton, Ltd.

Lawry, Sons & Co., of Hamilton, pork packers, are changing from steam to electricity for power, and have placed an order with the Royal Electric Company for a 30 h.p. two-phase "S.K.C." induction motor. They are also lighting their factory throughout by electricity.

An electric cab company has been formed in Toronto by Geo. A. Cox, H. H. Fudger, A. E. Ames and others, which will build horseless carriages in the shops of the Canadian General Electric Co., Peterborough, under the Fischer patents. The equipment is storage batteries.

The Canadian Development Company of Victoria, B.C., has been building a steamer on Lake Bennett, Yukon Territory, and expects to have it ready for its trial trip by April 1st. The boat is lighted throughout by electricity; the plant being furnished by the Royal Electric Company of Montreal, consisting of a C. W. multipolar dynamo, direct connected to a horizontal ideal engine.

A company has been organized to operate the Buffalo Railway Co., the Buffalo Traction Co., the Buffalo, Bellevue & Lancaster Railway Co., the Buffalo & Niagara Falls Railway Co., the Buffalo & Lockport Railway Company, the Niagara Falls Park & River Electric Railway Company (Canadian), the Niagara Falls & Clifton Bridge Company, and the Lewiston & Queenston Heights Bridge Company.

The corporation of the town of Barrie has been advertising for tenders for alternating current apparatus. The contract for one 120 k.w. "S.K.C." two-phase alternating current generator for power and lighting apparatus was awarded to the Royal Electric Company of Montreal. The entire lighting and steam plant which has been taken over by the corporation from the Barrie Gas & Electric Company, is being rebuilt and the capacity enlarged.

The Kay Electric Co., Hamilton, Ont., is very busy, and is working overtime.

The Electric Light Co., of Megantic, Que., has been incorporated; capital, $10,000.

Peterborough, Ont., proposes to develop water power for electric supply on the Otonabee river.

The Magnetawan, Ont., Tanning and Electric Co., Ltd., has increased its capital from $50,000 to $100,000.

F. Poste, recently a student at the Canadian General Electric Co.'s works, Peterborough, Ont., has assumed the management of the Prescott Electric Light Co.

The Central Mnfg. Co., Chattanooga, Tenn., U.S., furnished the pins for the Niagara Falls power plant, as well as the pins and cross-arms for the Lachine Rapids power plant.

At the annual meeting of the Hamilton, Ont., Street Railway Company the old directors were re-elected, and Edward Martin, Q.C., was elected president, John A. Bruce was elected vice-president.

The Sturgeon Falls, Ont., Electric Light and Power Company, Ltd., has been incorporated with a capital of $20,000. The provisional directors of the company are: E. A. Bremner, W. G. Finley and P. H. Patriarche.

At the annual meeting of the Cataract Power Company, Hamilton, the following directors were re-elected: Hon. J. M. Gibson, pres.; James Dixon, vice-pres.; John Moodie, treas.; John Patterson, sec.; J. W. Sutherland and J. A. Kamerer.

J. D. Guay, C. Leon Parent, F. X. Gosselin, J. E. Alfred Dubuc, managing director of the Chicoutimi Pulp Company, Chicoutimi; C. Angers, M.P., Saint Etienne de la Malbaie, and Onezime Cote, Bagotville, are applying for a charter as the Chicoutimi Water and Electric Co.; capital, $125,000.

At the annual meeting of the Hamilton, Grimsby and Beamsville Electric Railway Company a dividend of 5 per cent. was declared, and the directors were elected as follows: C. J. Myles, pres.; W. J. Harris, vice-pres.; L. Bauer, Robert Ramsay, A. H. Myles, John Gage. A. J. Nelles was reappointed secretary and manager.

The Niagara Falls, St. Catharines and Toronto Railway Company is applying for incorporation with power to take over the St. Catharines and Niagara Central Railway Company, and to extend to Port Dalhousie and Hamilton; also to acquire, generate, use and sell electric power; and operate steamboats, wharfs, etc.

The Packard Electric Co., Ltd., St. Catharines, Ont., is placing on the Canadian market Brunt's regulating socket, which is claimed to control the electric light as easily as a gas burner does gas light. There are five degrees of light, from two candle-power to sixteen, and a positive saving of current is claimed. This socket is specially valuable for the sick room, vestibules, sleeping apartments, etc.

The number of electric lighting companies in Canada for the fiscal year ending June 30th, 1898, was 267. The revenue derived from the inspection of electric light was as follows: The fees for the inspection of meters, etc., $5,388.25; for registration of companies, $3,900, and for penalties, $114; making a total of $9,472.25. The expenses of inspection (annual), were $3,236.10, the amount expended on standard instruments, etc., $3,768.80, leaving a net revenue of $2,467.35.

At the annual meeting of the Bell Telephone Company the following statement was submitted: 1,637 subscribers have been added during the year, the total number of sets of instruments now earning rental being 32,082. The company now owns and operates 343 exchanges and 340 agencies. Six hundred and sixty-six miles of wire have been added to the long-distance in 1898; of these, 326 miles are in the Ontario department, and 340 miles are in the Eastern department. The long-distance lines now owned and operated by the company comprise 17,233 miles of wire on 6,096 miles of poles. The financial statement showed that the net revenue for 1898 amounted to $331,151.74, out of which $263,779.93 were paid in dividends, leaving a balance of $67,371.81, which with the balance from 1897 of $82,364.17 makes a total balance carried forward of $149,735.98. The following directors were elected: C. F. Sise, Robert MacKay, John E. Hudson, Robert Archer, William R. Driver, Hugh Paton, Charles Cassils and Thomas Sherwin.

The Ontario Government gave the electrical industries quite a shaking up in the budget speech, which announced taxes on telephone, telegraph and electric railway companies.

The Royal Electric Company of Montreal has just completed the installation of a 100 h.p. "S.K.C." synchronous motor in the Iron Mask Mine at Rossland, B.C., to operate the hoisting machinery and air compressors.

The amalgamation is announced of the W. A. Johnson Electric Company and the Toronto Electric Motor Company, Ltd. About a year ago the business of the Toronto Electric Motor Company was reorganized as a joint stock company, J. W. Thompson at that time purchasing an interest and combining with it the manufacturing business formerly carried on in Hamilton under the style of the Thompson Electric Company. Recently Mr. Thompson has secured control of the entire business of the Toronto Electric Motor Company, Ltd. This company and the W. A. Johnson Electric Company have amalgamated their manufacturing business under the style of the "United Electric Co., Ltd;" capital, $150,000, with head offices at 134 King street west, Toronto. Both factories will be operated at present. Arrangements are, however, being made for a considerable extension of their manufacturing plants. The officers of the new company will be: W. A. Johnson, president and managing director; J. W. Thompson, secretary and treasurer; J. Norman Smith, engineer-in-charge of works.

The Mercury, Renfrew, Ont., says recently: We have always understood that the average life of an incandescent lamp was 800 hours. Some live considerably less. Others more. Two of these have their death recorded in the following fashion by A. A. Wright in a letter to the Packard Co.: These lamps have burned an average of ten hours a day since installed and every day. Consequently their life has spanned some 20,350 hours. It was somewhat remarkable, too, that having both lived so long they should have gone out so nearly together. Their epitaph is as follows: In faithful memory of Incandescent Packard, jr., and Incandescent Packard, sr., twin sisters. They were born of an honorable parentage, viz., The Packard Electric Co., now of St. Catherines, Ont. They each entered this life and commenced their remarkable career, Dominion Day, July 1st, 1893. Having commenced their labors on the switchboard in A. A. Wright & Co.'s Electric Light Station, Renfrew, Ont., on the installing of their electric light plant on the above mentioned date, they there burned faithfully and well every night without intermission until the time of their death. I. P., jr., departed this life, Feb. 1st, 1899, at the ripe old age of 5 years, 7 months; I. P., sr., shuffling off this mortal coil a few days later, Feb. 9th, 1899, at the advanced age of 5 years, 7 months and 9 days. During all these years they let the light shine in the above mentioned place every night, laboring side by side, thus setting an honorable example to all their neighbors, and saying in their peculiar way, "Go thou and do likewise."—(If you can).

Orillia, Ont., has awarded the contract for the electric power transmission plant subject to the by-law being approved of by the ratepayers. The Central Construction Co., Buffalo, is contracting for the entire equipment. The Stillwell, Bierce & Smithvale Co., are sub-contractors for the water wheels. The electric machinery will be furnished through W. A. Johnson Electric Company, of Toronto, the plant to consist of two 400 h.p. revolving field Westinghouse, three-phase 60 cycle generators, each having an overload capacity of 60 per cent. These will be located at the Ragged Rapids on the Severn river, eighteen and a half miles from Orillia. There will be provided the necessary high tension switchboards and controlling apparatus. Six step-up 100 k.w. static transformers, self-cooling type, will raise the voltage to 22,000 for the transmission line. At the receiving station at Orillia there will be six step-down 100 k.w. transformers of a similar type, to reduce the pressure to 1,000 or 2,000 volts, so that the alternating incandescent circuits now used for commercial lighting can be connected direct to the above transformers. There will also be provided a 25 h.p. Tesla induction motor, for driving the waterworks pump, now operated by steam, and a 50 h.p. motor of same type to drive the three ball, 25 light, arc dynamos, which have been used for street lighting for some years. The switchboard apparatus, lightning arresters, etc., have been carefully selected and so arranged that uniform service and safety in handling can be relied upon, notwithstanding the high voltage.

Railway Matters.

It is reported that a union station will be built at Megantic for the use of the Canadian Pacific and Quebec Central Railroads.

The Dauphin railway is going to establish workshops at the town of Dauphin, and machinery has already been ordered for their equipment.

A million dollar scheme is on foot in Montreal to elevate the G.T.R. tracks in Montreal and do away with the level crossings, some of which cause a great deal of complaint.

The Midland Railway Co., Nova Scotia, has bought from the Canadian agent of the Carnegie Steel Company, the rails for the road now being constructed between Windsor and Truro.

The Nickel Range Railway Company is applying for a charter to build a railway from the Algoma branch of the C.P.R., between Whitefish and McNaughton stations, to the main line of the C.P.R. at Chelmsford station, Ont.

W. G. Reid, contractor for the Midland, N.S., railway, has awarded to the Dominion Bridge Company the contract for the steel superstructure required for all the bridges between Windsor and Truro, including those across the St. Croix and Shubenacadie, or about seventeen spans.

The British Columbia Government has cancelled grants made to McKenzie & Mann by the former Government for the construction of a line of railway from Penticton to Boundary Creek; from Penticton to Point Roberts, 200 miles, and from an ocean port in British Columbia to Teslin Lake, 400 miles.

A British Columbia charter is asked for a railway from Log Cabin, on the White Pass, in the province of British Columbia, by the most feasible route, to a point at or near the Taku Arm of Tagish Lake; then to Atlin City, on the shores of Atlin Lake; and thence to Telegraph Creek, on the Stickine River, all in the province of British Columbia.

At a meeting of the directors of the C.P.R. Co., February 6th, the usual 2 per cent. on the preference stock was declared, and a dividend of 2 per cent. was also declared on the ordinary stock, making with the dividend already paid 4 per cent. for the past year. The results for the year were: Gross earnings, $26,138,977; working expenses, $15,663,605; net earnings, $10,475,372. The income from other sources was $423,367, making total net income $10,898,738. The fixed charges, including interest on land bonds, were $6,774,321, leaving net revenue available for dividends, $4,124,417. Out of this a dividend of 2 per cent. on the preference and 2 per cent. on the common stock for the June half year was paid in October last. After the payment of the dividends now declared the surplus for the year carried forward is $1,051,708.

J. R. Booth has given the Canadian General Electric Co., Ltd., a contract for the installation of an electric plant to transmit current for motive power and lighting purposes from his mills at the Chaudiere Falls on the Ottawa to the new Canada Atlantic Railway shops, 3½ miles distant. The contract covers two 150 k.w. three-phase revolving field, 4,000 volt, 60 cycle slow speed generators with switchboard arranged in such a manner that they may be operated single or in multiple. There will be installed at the car and lomotive shops three 130 h.p. 4,000 volt three-phase self-starting synchronous motors, each of which will be connected with the main shafts by means of rope drives and clutch pulleys. The company has also supplied for the large locomotive transfer table, a suitable motor drawing current from conductors placed beneath the floor, and fed from a transformer system at 500 volts. For lighting purposes there will be used sixty alternators, enclosed six ampere arc lamps specially adapted for factory use, together with some 400 16 c.p. incandescent lamps, all of the C.G.E. Co.'s make. The transmission here will consist of three No. 4 B.S. bare copper wires carried on porcelain insulators and extra heavy pole line, which will follow the line of the Canada Atlantic Railway the entire distance.

Trains are now running on the White Pass Railway.

It is said that the Lake Erie & Detroit River Railway Company, the purchasers of the Erie & Huron, will spend $50,000 in building shops at Sarnia and Port Huron. As soon as the shops are completed the car ferry "Huron" will make regular trips between Port Huron and Sarnia.

The Bedlington and Nelson Railway Company is applying for running powers over the Crow's Nest line of the Canadian Pacific Railway. The proposed line would lessen the distance between Kootenay Lake and Bonner's Ferry by 53 miles. The Bedlington road is owned by English capitalists, and when a change was made two years ago, work on the railway was stopped, although the line was staked. Meanwhile the C.P.R. secured the charter for a line from Lethbridge to Nelson through the Crow's Nest Pass.

The Canadian Pacific Railway Company is applying for permission to operate a railway from its Stonewall branch, Manitoba, northerly and northeasterly to a point on Lake Winnipeg between Gimli and Arnes; and also a railway from a point on the one last named, thence in direction generally northwest to a point on the east shore of Lake Manitoba between Marsh Point and the north boundary of township twenty-five; and also a railway from Reston, on the company's Souris branch, in a general westerly direction to the Moose Mountain district, thence in a westerly direction to Regina.

Mining Matters.

There have been received some very fine specimens of gold quartz from the Atlin country, B.C.

Ottawa will have a large mica factory. It will be operated by the Eugene Munsell Company, of New York.

A very rich find of gold is reported from McDonald Creek, Northwest Territory. It is close to the boundary line of British Columbia and the Northwest Territory.

Next summer will witness a greater boom than ever at the Bell Island iron mines in Newfoundland, as the company expect to have 600 men employed on April 1st.

The Centre Star mine at Rossland, B.C., is to be developed and the stock placed on the market, by the same group of capitalists which gave the War Eagle mine such a boom.

W. D. Pettigrew, Winnipeg, who is developing mines at Wabigoon, Ont., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for hoisting, crushing and pumping plants.

The Lake Manitou Gold Mining Co., St. Paul, U.S., has placed an order with the Jenckes Machine Co., Sherbrooke, Que., for a ten stamp mill to be erected on its property near Wabigoon, Ont.

John D. Chipman of St. Stephen, representative of the English company now in control of the Chronicle Co., N.B., nickel deposits, learns that the shipments of ore have proved satisfactory.

The John Sykes Mining and Milling Co., Toronto, has purchased from the Jenckes Machine Co., Sherbrooke, Que., a ten stamp mill, engine, boiler and saw and shingle mill, to be erected immediately on its property near Dinorwic, Ont.

The East Bay Coal Mining Co., is said to be embarking in earnest upon its extensive oil-shale enterprise at McAdams Lake, C.B. Next summer will see extensive developments. The company's expert has recently been over the ground.

The Guffey-Jennings Gold Mining Co., at Caribou, N.S., it is reported, will tear down the old mill located on its areas and replace it with a modern plant comprising 40 to 50 stamps, together with the improved Wilfley Table Concentrator.

The present installation of 30 stamps in the new mill of the Dufferin Mine at Salmon River, was started the other day and everything found to run smoothly and in a satisfactory manner. The mill is arranged for a capacity of 60 stamps, which will give when running a crushing ability of 240 tons every day of 24 hours.

The Hammond Reef Gold Mining Co., Toronto, has decided to install at once, thirty additional stamps, a new crusher, aerial tramway and water power plant, to operate the new mill. It is expected that the whole of the machinery will be delivered early in April. The Jenckes Machine Co., Sherbrooke, Que., has been awarded the contract.

The Hall Mines, Ltd., Nelson, B.C., was expected to start the treatment of lead ores in its smelter about March 1. The company has made a contract with the management of the Queen Bess, a Slocan mine, for the output of that property for the next three months. In addition to this ore, the company is receiving regular shipments from several of the silver-lead mines in the Slocan, as well as from some of the properties around Ainsworth.

Early in December a very rich find of platinum was made on the Hootalinqua, Yukon. Black sand is found in nearly every stream of the Yukon Territory, and while considered a good indication of gold, is always a nuisance to washers. On account of its great specific gravity it remains in the sluice boxes with the gold, and even hand panning will not always separate the two. Twelve pounds of it was taken from near the mouth of the Hootalinqua and found very rich.

The improved condition of the New Glasgow and Bluenose mines, at Goldenville, N.S., is well illustrated in the returns for the month of December last. From 1,500 tons of quartz 650 ounces of gold were obtained, valued at $12,500. The cost of mining and crushing this quantity is stated to have been about $3 per ton or a total cost of $4,500, leaving a balance of profit on the month's operation of $8,000, which, it must be confessed, is a very handsome return.

At the annual meeting of the Hammond Gold Reef Mining Company, the directors in their report to the shareholders announced a policy of active operations for the immediate future. Upon that report the stock has been very active and has made rapid advances in price. A meeting of the directors was held in this city yesterday and a contract was closed with the Jenckes Machine Company of Sherbrooke, for thirty additional stamps, the necessary ore crushers, aerial rope tramway, frue vanners, water wheels, etc. This will give the company a thoroughly equipped 40-stamp mill, and will make it one of the largest and most complete free milling gold mill plants in Canada. A contract has also been let to the Canadian General Electric Company for generators, motors, electric line and complete equipment for the production and transmission of electric power from Clearwater Falls, a distance of less than two miles.

Marine News.

The St. Lawrence canals will be opened for traffic May 1st.

Northwest Transportation Co., Sarnia, Ont., is putting in new boilers in the S.S. "United Empire."

Toronto recently sent a strong deputation to Ottawa to urge the claims of the city to harbor improvement.

The dry dock at St. John's Nfld., was resorted to by 26 vessels in the past year, many of which were in need of considerable repairs.

Application is made to incorporate a company to construct a ship canal from Lake St. Clair to some point on Lake Erie between Point Pelee and Rondeau Harbor.

The C.P.R. declines to allow the city of Toronto to land the proposed chain ferry at the Queen's wharf at a lower rental than $1,500 per year, and so the ferry will remain in abeyance for another season.

The steamer "Minnehaha," which is being built at Seaton Lake, Lillooet, B.C., is a neat model. In the neighborhood of fifteen tons of freight can be carried.

The Canada Steamship Company, of which Sir Robert G. Head, of London, England, is president, and which is now organizing a transatlantic line between Milford Haven, Wales, and Paspebiac, has just prepared designs for the construction of an elevator at the latter place. It is intended to build it of corrugated iron. Its capacity will be 1,000,000 bushels of grain. The construction will begin shortly.

Extensive alterations are being made in the steamer "Greyhound" at St. Catharines, Ont. The steamer "Lakeside" is expected to commence running from St. Catharines to Toronto about the 15th inst.

Two semi-annual dividends of 3 per cent. each, amounting together to $104,400 were paid by the Richelieu & Ontario Navigation Co. during the financial year just closed, leaving the amount of $7,627.55 to be carried to the surplus.

J. L. Booth, Ottawa, stated recently that he would, during the coming season, build sixteen hundred feet more of dockage at Depot Harbor, for the further accommodation of grain to be shipped over the Ottawa, Arnprior & Parry Sound Railway.

Maine, U.S., shipyards are turning out five-masted schooners, and there are no less than four five-masters building in the Maine shipyards at present. The "Nathaniel Palmer," just launched at Bath, Me., is 205 feet long, 44-4 feet beam, 22 feet deep and 2,440 tons gross.

Collingwood Schreiber, Deputy Minister of Railways, has stated that M. P. Davis, contractor for the Gallops Canal, had been granted an extension of time to 1900 to complete his contract, but he will be obliged to provide tugs to tow vessels up stream, there being a sufficient depth of water, but a strong current. The Soulanges Canal contractors have been given to May 15th next to complete their work. There is, however, no certainty that they will be through in that time.

Personal.

T. A. S. Hay, C.E., has been appointed city engineer in Peterborough, Ont.

Geo. White Fraser, D.L.S., Toronto, is engaged on the survey of the boundary between British Columbia and the Yukon district.

We recently had a visit from J. B. Moore, representing the Ashcroft Mnfg. Co., the Consolidated Safety Valve Co., the Hayden & Derby Mnfg. Co.

Jenkins Bros., valves and packing, the famous New York and Boston house, is now represented in Canada by H. C. White, who is just now making the round of the trade.

Wm. Butterick was accidentally killed in Deseronto, Ont., February 6th, at the Standard Chemical Works, by being caught in a shaft. His father is superintendent of the Rathbun Co.'s lumber mill.

Hugh Ryan, the contractor who built the Sault Ste. Marie canal, and in the earlier days a large section of the G.T.R., died in Toronto, February 13th, leaving an estate of almost one and a half millions of dollars.

D. C. Smith, who travels in Canada for Henry G. Thompson & Son, New Haven, Conn., U.S.A., has recently visited Toronto in the interest of that firm's famous hack saws, and band, power and jig sawing machines for cutting metal.

It is reported that Mr. Louis Coste, chief engineer of the Public Works Department of Canada, has forwarded his resignation to the Minister of Public Works. His purpose is understood to be to take the management of the Dominion Yukon Mining Company.

George C. Morrison, Hamilton, Ont., died recently at his home. Mr. Morrison was a native of Kirkentulloch, Scotland, but came to this country when a very young man. About 34 or 35 years ago he came from Galt to be foreman in Beckett's Engine Works, and 30 years ago he went into business for himself, starting the engine and boiler works which he has ever since carried on in Hamilton.

FIRES OF THE MONTH.

Jan. 31st. American Bent Chair Co., Owen Sound, Ont., loss, $150,000.——Feb. 7th. The Columbia River Lumber Co.'s (Vancouver) sawmill at Moberly.——Feb. 11th. Dunn's sawmill, Sault Ste. Marie, Ont.; loss, $5,000.——Feb. 12th. L.E. & D.R.R. Co. round-house, Sarnia, Ont.——Feb. 13th. The Geo. Gillies Co.'s bolt works, Gananoque, Ont.; $12,000 damages.——Feb. 13th. A large portion of Digby, Ont., was burned down.——Feb. 14th. Wm. Law & Co.'s wharf, Yarmouth, N.S.——Feb. 14th. J. Saunders' wood-working and blacksmith shop, Sunderland, Ont.; loss, $1,000.

A NOVEL METHOD OF SEWAGE DISPOSAL, ESPECIALLY DESIGNED FOR THE CITY OF TORONTO.

(Concluded from January issue).

In the foregoing, the lift from the pump well to the filtration area, recommended by Mr. Rust, has been assumed to be only 70 feet vertically. This is not correct, the elevation being much greater, as I am now reliably informed. So much so, indeed, as to bring the annual cost of maintenance by my combined method, up to $100,000 or more. This, in view of the much more economical second alternative plan, is almost prohibitive. The artificial filters referred to may now be considered as offering the better method of subsidiary, and final purification. The long, narrow spit of land between Ashbridge's Bay and Lake Ontario presents an excellent location for the small area required, and can be reached by gravity within a moderate distance from the coke and combustion works, should local circumstances prevent their location in close proximity to the latter.

The half acre of coke and six acres of sand and gravel filters already mentioned, would be sufficient, as at Reading and Glasgow, but, inasmuch as coke would require frequent renewal, and the other materials are to be had in abundance in the locality designated, it would be more economical to lay out 8 or 10 acres of sand and gravel beds at a maximum cost of, say $40,000. The probability is that quite sufficient material is on the spot *in situ*, and that the filters, on a much more extensive scale, and at very much less cost, could be made out of the sand.

The total cost of the whole plant, including coke and combustion works on the line of the outfall sewer, the filtration area, and a possible mile of conduit pipe from the works to the filter beds, would be, approximately, as follows:

Coke and combustion works	$191,200
Land for above	10,000
Conduit pipe	40,000
Filter beds	40,000
Cost of land, right of way, etc	25,000
	$306,200

The artificial beds at Reading, Penn., U.S.A., cover an area of 57-100 acre, only, they filter 1,500,000 gallons of sewage effluent daily, and the preliminary coke straining of the "entire" crude sewage is by no means as thorough as it should be, the strainers being changed but once a week, and yet the effluent from these very small filters is satisfactory. In this case (Toronto), the heavy matters of the sewage are entirely held back from the coke strainers, there is constant aeration, and, with a larger filtration area, proportionately, can we not look for even better results?

No sludge, a minimized cost of construction, and a yearly cost for maintenance not exceeding $73,000, which covers the care of the filter beds.

The construction of half an acre of coke filter at the works (at the discharge end of the pumps), would add greatly to the purity of the effluent from the sand and gravel filters at Ashbridge's Bay, and be well worth the outlay. Such a filter would cost about $15,000, and bring the total outlay for construction up to $321,200. It would probably suffice to renew such a filter at the rate of, say ten tons daily, which, as the coke from the strainers in the receiving reservoirs, would be utilized as fuel, and pay for itself.

The fact that bricks are more or less magnetic in their properties has been recently demonstrated by H. E. Lawrence of the Physics Laboratory of Rochester University, Rochester, N.Y.; the investigation is still proceeding, and we will give details of the experiments when they have been completed. The magnetic instruments in the Observatory at Toronto are housed in a structure in which no brick was used, and the director states that they have had no trouble of the kind which led to the discoveries at Rochester.

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. D. THEUNISSEN, Cookshire, Que.

The Canadian Engineer

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For The Canadian Engineer.

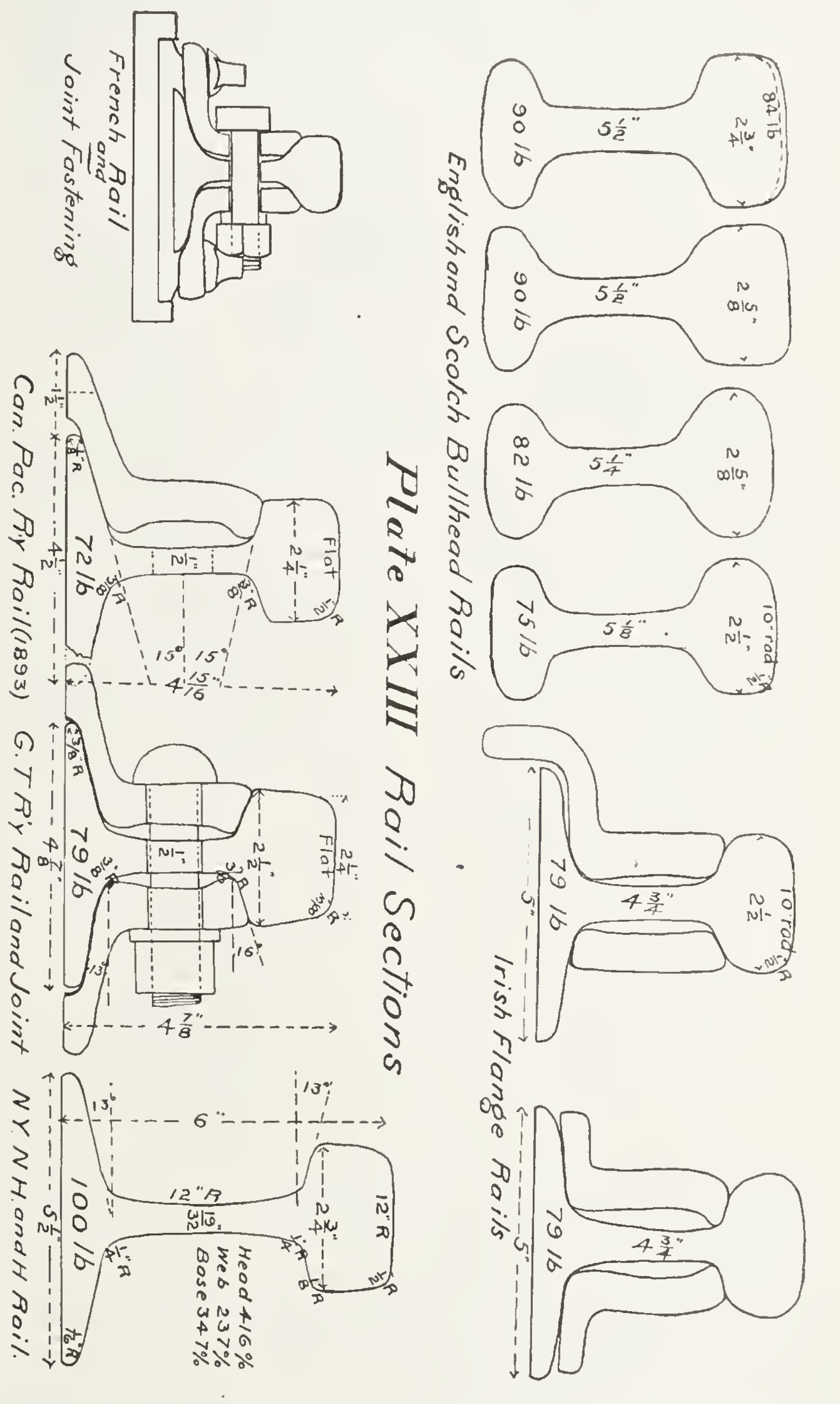
RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

ARTICLE 4.—RAILS.

The progressive history of rails from the first longitudinal wooden sleepers up to the present would be interesting but not in place here. We have arrived at two types, one used in England and Scotland, and in some British colonies and dependencies, etc., i.e, the bullhead or double-headed rail, resting in cast-iron chairs, the other used in the world generally, otherwise, (i.e)., the Viguoles or flanged rail, which is self-supporting.

(A) Plate XXIII. gives sections of bullhead rails, and on Plate XXV. is shown a cast-iron chair for fastening the rail to the ties, and which adds $1,500 to $2,000 per mile to the cost of the track. The original idea involved in the use of this section was to obtain a reversible rail which would double the wearing value if it could be turned over and used again after one head had worn down, but when it was found that the chairs damaged the rail so that they could not be reversed advantageously, this idea was abandoned, and the section now used has a much larger per cent. of metal in the head than in the base of the rail. The British railways use rather heavy rails considering the light rolling stock, but space their ties 2 feet 6 inches apart, centres, due to the superior supporting qualities of the cast-iron chairs; and, in general, the tracks are very solid and first-class, the rails being held to the chair-seats by long tapering oak keys which are tightened occasionally, while the chairs themselves are fastened to the ties with wood screws and bolts, and even those few British or Irish roads which use flanged rails use the same fastenings with tie plates, not trusting to spikes except at every other tie at the most. A special advantage in using rail chairs is that creosoted pine ties become available, and they are probably the most durable and economical tie in use, where it becomes possible to fasten the track securely to them.



(B) *Flanged Rails.*—The objections urged against flanged rails, that they cut into the ties, and that they cannot be held properly for heavy traffic with spikes, are overcome by adopting tie plates and screws or bolts for fastenings, and the idea that they are not rigid on curves is shown to be erroneous, as witness the very heavy engines of America running at high speed around much sharper curves than are used in England.

Plates XXIII. and XXIV. give sections of flanged rail of various designs and origins. In detail they will be found to vary widely, but with the exception of the New

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*Now issued in book form.

York Central rail, which has a narrower base for use with tie plates or steel ties, the height is usually equal to the width of base. The first difference noticeable is the per cent. of metal in the head. Other things equal, the more metal in the head the more wear will be obtained, but rails with relatively heavy heads never cool equally, causing initial strains in the section, and a deep heavy head will not get well rolled, and being spongy will wear rapidly when the top layer is gone. The endeavor now is to get a rail as hard as possible, chemically, that will stand drop tests, with a wide, moderately deep head, but not so deep as to induce sponginess in the centre of the head. A wide head is necessary with modern heavy engines to prevent undue crushing of the top surface, due to heavy concentrated wheel loads, and this forces a small proportionate depth of head to keep the per cent. of metal in the rail head from being excessive.

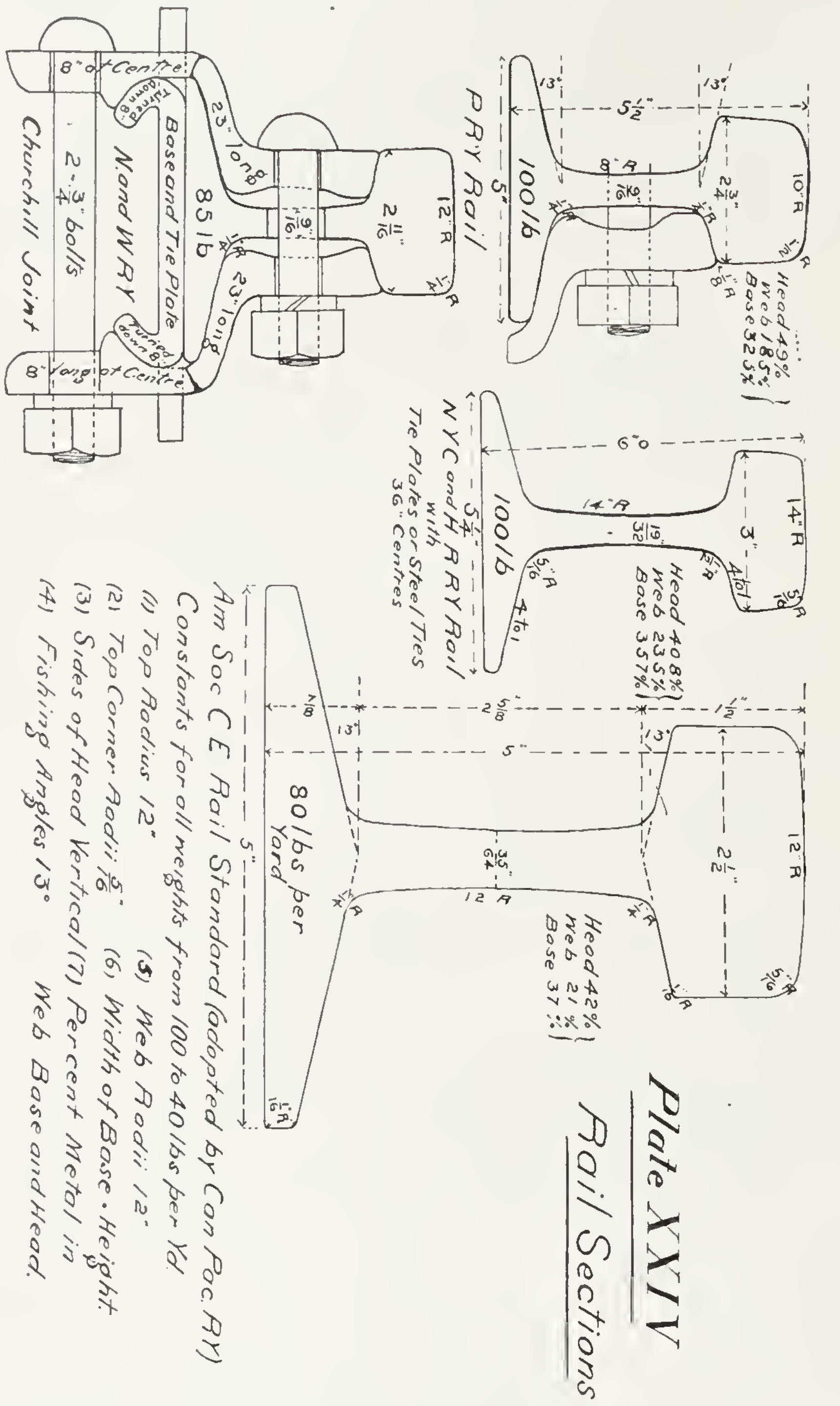


Plate XXIV
Rail Sections

Striking differences in rail design occur in the radius of the top of the head, the upper head corners, and in the side slopes of the head. The tendency in America is toward a flat top, sharp corners, and vertical sides, which is the reverse of English practice of round tops, easy corners and sloping sides, while fishing angles are getting flatter and tend to become standard at 13°.

Plate XXV. gives a standard U. S. wheel tread—rails after eleven years' wear on curves, and two drawings which contrast the fit of a wheel on a rail head of sharp corner radii with that on one of larger radii. It will be seen by the dotted lines that normal wear is upward and outward, thereby increasing the arc of contact between wheel and rail, thus also increasing the resistance and wear, so that the longer this can be deferred by starting with a sharp corner radius and vertical sides, the better, as the contact is then a rolling one only, and the wear and resistance small. Note that the radii of worn rail corners is still about $\frac{1}{4}$ inch, and investigation has shown that sharp radii of upper corners of rail heads do not cause sharp flanges on wheels, which has been the chief objection raised against them in the past.

Composition of Rails.—When steel began to replace iron as a material for rails it was found necessary to remove the notches in the flanges from the centre to the ends, and even omit them altogether to prevent breakage, the notches being put in the flanges of the angle bars instead, so as to prevent creeping of the track. Rails were made hard to stand wear. Then drop tests were introduced to detect brittleness, and soon forced soft rails to be used, but going to the other extreme the rail heads wore out very quickly, especially as the demand for cheapness produced insufficiently rolled rails. Now there is a gradual tendency to get as hard a rail, chemically, as will just stand the drop tests.

Specifications for Chemical Composition of Rails :

(1) Sandberg (Sweden)—Carbon, if alone, $\frac{5}{10}$ p.c., but only $\frac{3}{10}$ p.c. in presence of $\frac{1}{10}$ p.c. phosphorus ; silicon, at least $\frac{1}{10}$ p.c. to give sound ingot and make rail wear.

(2) G. T. R. (Canada)—Carbon, $\frac{4}{10}$ to $\frac{5}{10}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{7}{100}$ or less, silicon, $\frac{1}{10}$ p.c., manganese, $\frac{1}{5}$ p.c.

(3) New York Central Railway (Dudley)—60 to 70 lb. rail : Carbon, $\frac{45}{100}$ to $\frac{55}{100}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus $\frac{6}{100}$ p.c. or less ; 70 to 80 lb. rail : Carbon, $\frac{5}{10}$ to $\frac{6}{10}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{6}{100}$ p.c. or less ; 100 lb. rail : Carbon, $\frac{65}{100}$ to $\frac{75}{100}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{6}{100}$ p.c. or less.

Dudley, also regarding different constituents that affect the quality of rails, says : Manganese takes up the oxide of iron, and prevents red shortness, but over 1 p.c. makes rails not only hard but coarsely crystalline, with a tendency to brittleness, flowing easily under wear and oxidizing rapidly in tunnels. Silicon produces solid ingots, free from blow holes in columnar structure, with small compact crystallization. Sulphur causes red shortness and seamy heads ; it also tends to check welding of blow holes and ingot pipes. Phosphorus increases the size of crystals and produces brittleness ; it must therefore be very low in high carbon rails, which make prices higher, as most ores have phosphorus in them.

Physical Drop Tests for Rails :

(1) Intercolonial Railway of Canada—Supports 3 ft. 6 inches apart ; a rail 12 ft. long is to stand one blow of 2,000 lbs. falling 18 ft., and three blows falling 6 feet for 67 lb. rail, with a deflection of 3 to $3\frac{1}{2}$ inches for first, and $2\frac{1}{4}$ to $3\frac{1}{4}$ inches for second case. (Drop tests for U. S. roads about the same.)

(2) Irish Flange Rails.—(a) Supports 3 ft. 6 inches apart, a rail not to deflect more than $\frac{3}{8}$ inch with permanent set not more than $\frac{1}{8}$ inch for 30,000 lbs. at centre for 30 minutes. (b) Same supports, rail to stand 2 blows without breaking, and not to deflect more than 1 inch for 2,000 lbs. falling 8 feet.

Under wear the top surface of a rail head gets more or less cold-rolled and brittle for about $\frac{1}{32}$ inch, which is the cause of heads breaking downwards (e.g.) a broken wheel may hammer and cause the brittle layer at top to crack, and the crack will continue on down until the rail breaks. High stiff rails with a broad head are more needed as the wheel loads on drivers get greater, so as to keep a decent track and prevent cold rolling. (Large drivers are not so hard as small ones on track.)

The endeavor is to get a high carbon rail and work it until it is tough and compact in texture in the head.

ARTICLE 5.—RAIL JOINTS.

While great progress has been made in the strength and rigidity of rail joints, they can hardly be considered yet equal to the criterion of simplicity, and of being as strong as the rail itself, and as stiff laterally. Sandberg, by watching the effect of trains on narrow notches cut in the heads of solid rails, concluded that the lipping down was due to lack of support of the fibres, and that we may, therefore, not expect to ever obtain a joint so perfect as to prevent this wear entirely. Various joints are shown on Plate XXVI., and also special ones attached to rails on Plates XXIII. and XXIV. Of these the simple fish plates were considered sufficient in early railroad days, when wheel loads were light and speeds not excessive, but, as these increased, the joints could not be kept in surface, and a lower flange was added, giving us the angle bar, which is the ordinary standard form to-day. It is simple, easily attached, etc., and may be used as a suspended joint on two ties with four bolts, or a longer one (44 inches), with 6 bolts, is often used, resting on three ties, and although more expensive, gives better results.

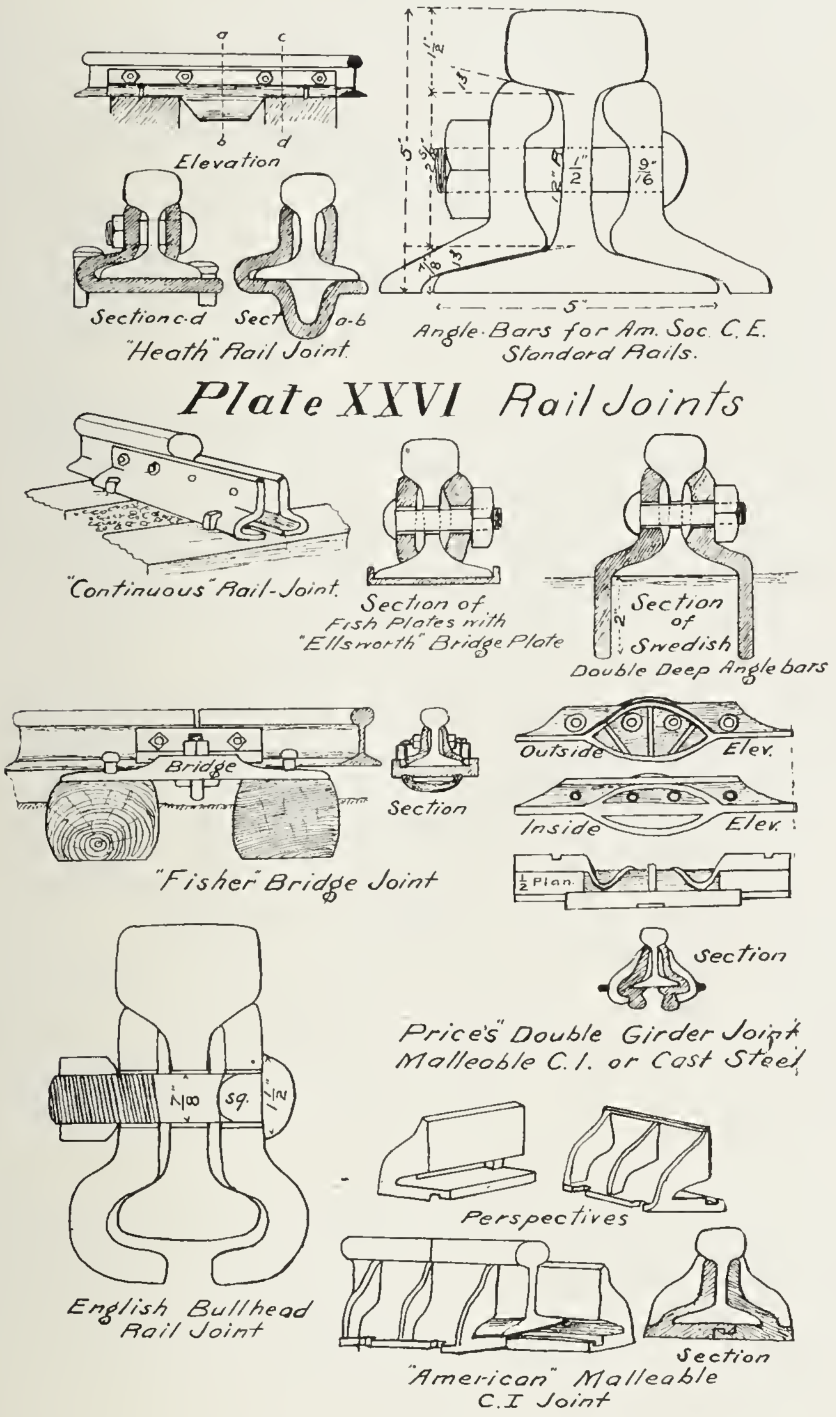

a
c
b
d
Elevation
Section c-d
Section a-b
"Heath" Rail Joint
Angle-Bars for Am. Soc. C.E. Standard Rails.
5"
"Continuous" Rail-Joint.
Section of Fish Plates with "Ellsworth" Bridge Plate
Section of Swedish Double Deep Angle bars
Bridge
Section
"Fisher Bridge Joint"
Outside Elev.
Inside Elev.
½ Plan
Section
Price's Double Girder Joint Malleable C.I. or Cast Steel
Perspectives
English Bullhead Rail Joint
Section
"American" Malleable C.I. Joint

Plate XXVI Rail Joints

A comparison was made in Sweden between :

(1) Fish plates with Ellsworth base plate.

(2) Angle bars.

(3) Double deep angle bars with 2-inch extension downward between the ties.

The renewals for flattened ends in five years were (1) $6\frac{4}{10}$ p.c., (2) $14\frac{4}{10}$ p.c., (3) $17\frac{6}{10}$ p.c., but as for stiffness they were (1) $\frac{1}{3}$, (2) $\frac{2}{3}$, (3) 1. So that Nos. (2) and (3) were considered superior, particularly owing to their simplicity, but as No. 3 was easily heaved by frost and snow it was considered suitable for milder climates, and the choice rested on the angle bars.

The Fisher bridge joint has been tested quite extensively, and is found to be very stiff vertically, but weak laterally, and its various parts are rather expensive and more complicated than the angle bars. For these reasons it is not likely to find extensive favor. The Churchill joint of N. & W. R. R. is probably the most efficient joint yet designed as far as stiffness, etc., and is intended for use with 60 ft. rails. Otherwise it would be too expensive and complicated for ordinary use. The other joints shown appear to have good points, but are of less tried merit. (Also see *Engineering News*, page 178, Vol. I., 1891, for Paterson rail joint.)

We may expect, ultimately, to obtain a joint as strong as the rail itself, but how simple it can be made is for the future to show.

ARTICLE 6.—RAIL FIXTURES, ETC.

The weak spot of our track is its attachment to the ties by ordinary track spikes. Their heads are often cracked by excessive driving, re-spiking is frequent, and the ties get split and rotten much sooner than they would naturally, and while Greer, Goldie, curved, interlocking and other special spikes are improvements on the dog spike, yet the final solution would seem to be in some positive fastening such as wood screws or fang bolts, such as are used to hold rail chairs to the ties on British roads, and while tie plates and selected oak ties are keeping off the evil day, yet as speeds get higher and engines heavier, demanding a high stiff rail, this must be done by heavy traffic roads sooner or later, either with wooden ties and tie-plates, or with steel ties and bolts.

Tie plates (such as Goldie, Servis, Standard, Sandberg, etc.) will enable roads even with heavy traffic to use soft wood ties and a high stiff rail with narrow base (see N. Y. C. & H. R. R. R. section), and will prolong the life of ties. They are being adopted rapidly, some roads using them on curves only, others for the whole track. Wood screws for holding track are of steel, seven inches long, with thread for 4¾ inches, ¾ inch diameter, and have a pulling resistance of about six tons. Fang bolts are attached by boring holes through the ties, and screwing the bolts, which have heads on them suitable for holding down a rail, into a nut, with a fang on it. This fang grips into the wood on the under side of the tie, which prevents it turning or loosening.

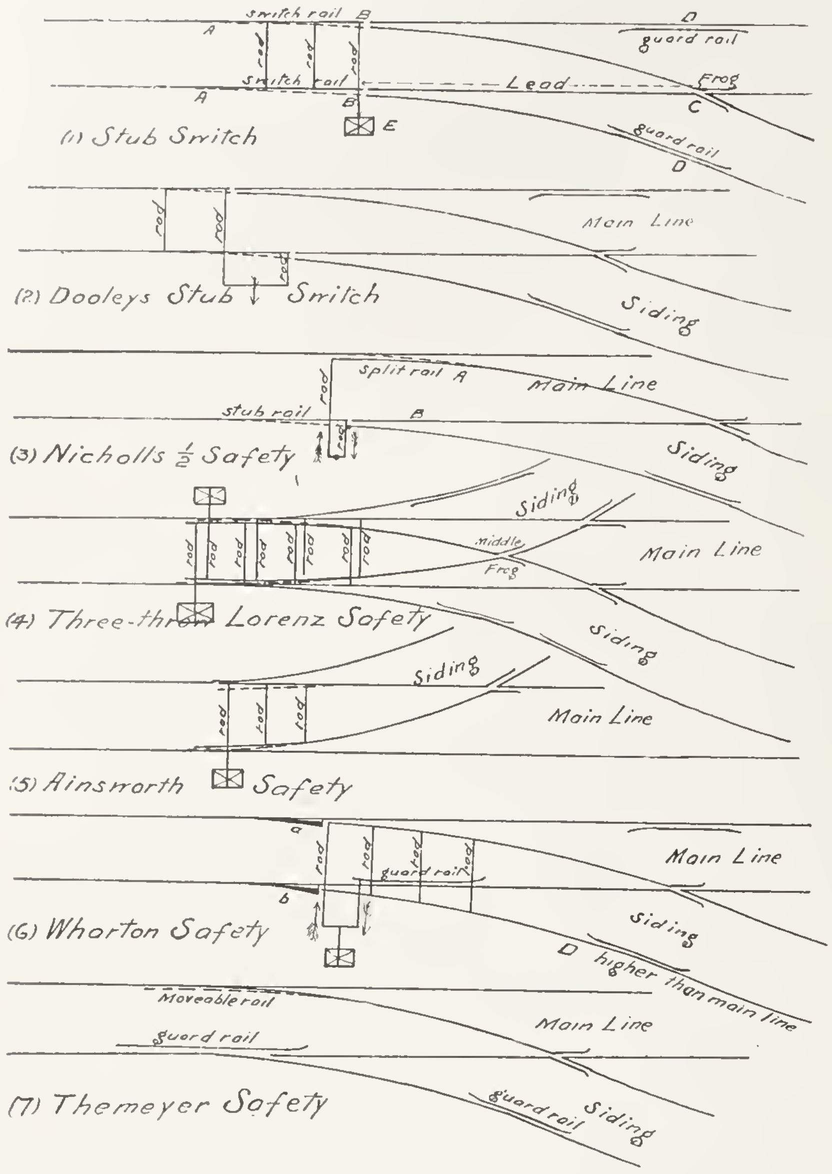
The vibration caused by passing trains would soon loosen the ordinary nut on the bolts which fasten the angle bar joint to the rails, and, in order to prevent this, many devices have been tried. The double nut is not effective. A gravity lock outside the ordinary nut in the form of an eccentric nut is much better, and Young's patent has been used quite extensively, but the spring nut lock, which consists of one turn or a little more, of a strong steel spiral, with two cutting lips taking hold of angle bar and nut as the nut is screwed on, on top of the nut-lock, is the kind generally used, and being simple, cheap and effective, is likely to remain the favorite kind in use.

ARTICLE 7.—SWITCHES AND FROGS.

Outlines of various designs for passing a train from one track to another are given on plate XXVII., but of course there are various forms of attachments differing in detail only.

(1) The Stub switch consists of two movable rails, A B, with the ends B supported, and free to slide on plates for a lateral distance of five inches, called "throw." These switch rails or points are from 10 to 25 feet long, depending on the frog distance, B C, and the angle of the frog C. The guard rails, D D, prevent derailment at the throat of the frog. The stub switch works for a three-throw as easily as for a two-throw turnout, and can be made into a safety switch (see Cook Switch, Plate XXVII., and Dunn Switch, *Engineering News*, Vol. II., 1890, page 174), and is considered to be more durable and easily kept in working order with snow and ice than are the many forms of split rail switches.

Plate XXVII. Turnouts.
(outlines of Systems)
all switches set for main track.



(2) Dooley's stub switch is a modification which makes easier riding by having one point longer than the other, substituting two jolts for one severer one, but it is not as rigid as the ordinary stub switch.

(3) Nicoll half-safety switch is a compromise between the stub switch and a split or Lorenz switch. It is not at all a strong or secure switch, as the two rails are not opposite each other. Its advantages are not very obvious.

(4) Lorenz safety switch is the model of various split switches. Both rails are feathered down so as to fit close up against solid rails. One is a main line rail, the other for the siding, connected so as to act together. This switch is adapted to position where the traffic is considerable on the branch line, or turnout, and in climates not troubled with ice or snow, but the split rails or points wear out rapidly, and it is more complicated when applied to three-throw turnouts, necessitating two sets of switch rails, stands, etc., set one ahead of the other, in which case neither of the main line rails are solid. The Stewart switch (*Engineering News*, Vol. I., 1895, page 59) has a special feature in making the switch rails by bending over solid-headed rails, instead of planing them down to a point. It is claimed this will give durability and rigidity.

(5) Ainsworth safety switch is made by giving the solid siding rail a sharp bend or recess, and the corresponding switch rail is left square ended, thus providing a more solid track for the main line, and a more durable switch rail. This form is adapted to branch lines having little traffic.

(6) Wharton safety switch is used for heavy main line traffic. It gives a solid main track. The siding rails lead the wheels onto blocks (a.b.) higher than the main line rails, and fall down on to the main line, while in facing the switch the wheels are first lifted by the blocks (a.b.) and then carried over the main line rails by the wheel tread riding on the high rail D.

The Macpherson switch (Plate XXVIII.) is a modified Wharton coming into use on the Can. Pac. Ry. The main line is solid, and the train is thrown onto the siding by having the outside movable rail higher than the main line, and a movable guard rail which is also higher than the main line, but which is thrown into position only when the switch is set for the siding. This design also includes a special form of frog, which is a sliding plate brought into position by means of bell-crank levers and rods operated from the switch stand, when set for siding; when set for main line the plate is clear of the main line, leaving the main line solid at this point also. This design has been in use since 1892, and it has proven itself very satisfactory and durable.

(7) The Themeyer safety switch has one movable split rail, and a stationary split rail or half-frog and guard rail. The movable rail and guard rail guide the wheels onto the siding when set for it. It is successfully used on the B. & O. R. R.

The main object of safety switches is to make it safe for a train to trail through a switch from the siding, when it is set for the main line, or vice versa, and this is accomplished, with split switches, by using springs which allow the movable rails to be forced aside just enough to pass the wheel flanges through. The springs then force the switch points back to the position for which the stand and signal are set.

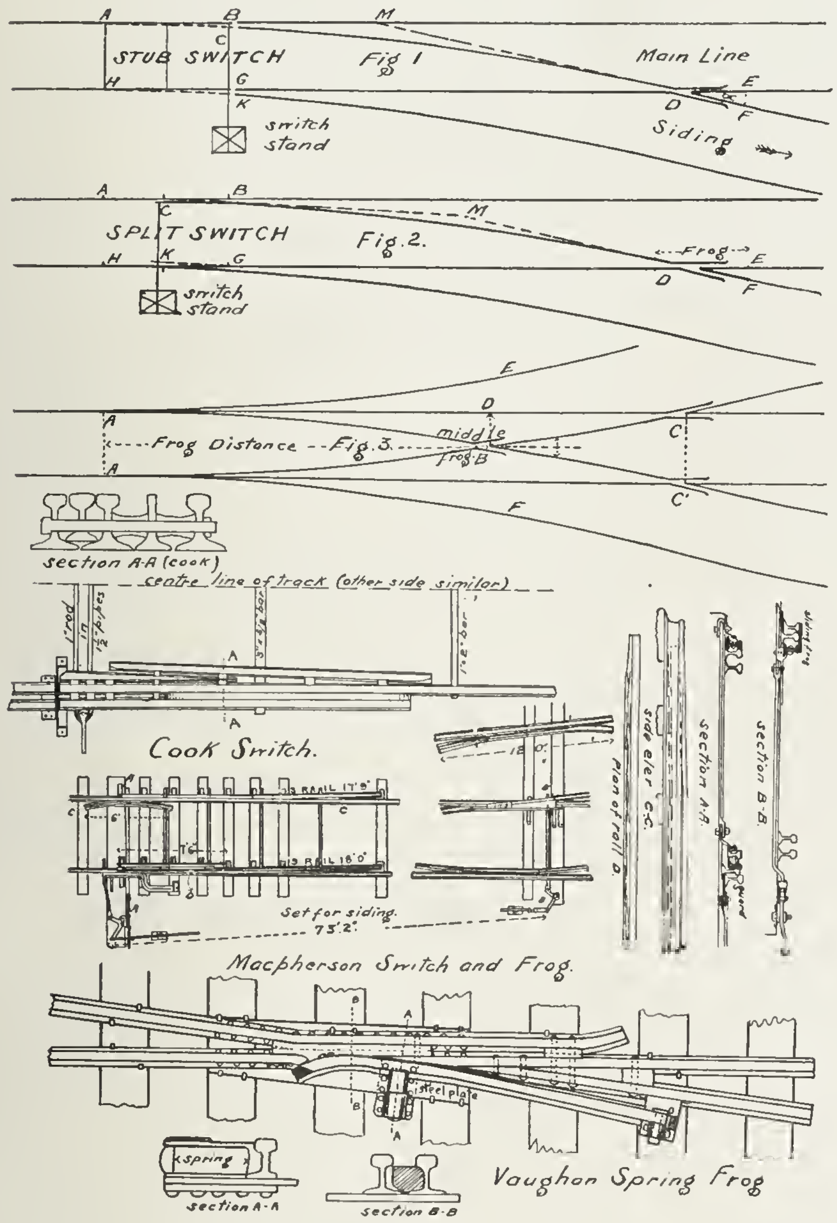
Other special switches of tried merit are the cam automatic, in which the split rails are fixed, and the solid ones move horizontally (see *Eng. News*, vol. I., 1890, page 489), and the Duggan switch, which has two knuckle-jointed vertical moving split rails. (See *Eng. News*, vol. I., 1893, page 390.)

Frogs.—Formerly cast steel solid frogs were common, but as they were more liable to crack, and when worn in one part were unfit for use, they were soon supplanted by frogs made up of pieces of steel rail fitted and bolted together onto a flat steel base plate—any worn part can be easily replaced. Such solid or stiff frogs are in most general use, but on main lines having heavy traffic, those turnouts with light traffic are now generally fitted with spring frogs (see Plate XXVIII.) in which either the "point" or the guard rail are movable, and the main line is normally a solid track. A train to or from the siding forces the frog open momentarily, and a spring brings it back again as soon as the train has passed, leaving the main line again solid. The defect in many of these spring frogs is the tendency to derail wheels with worn treads and flanges, by forcing open the spring frog when a train is on the main line. It is claimed that the Vaughan spring frog, used on the Penn. R. R., overcomes this difficulty by blocking up the tread. Other spring frogs of special features of merit are the Monarch, Ramapo and Pegram, described in the *Engineering News* since 1890.

Turnout Calculations.—The "lead" is the distance

KD (Plate XXVIII.) from the switch stand to the frog point. The fixed end of switch rails is the "heel," and the movable one the "toe." The "throw" is the amount which the switch stand rod moves the "toe" of the switch. It is 5 inches for stubs and 3 inches for split switches. To designate a frog angle $E\ D\ F$ the ratio $\frac{ED}{EF}$ is called the frog number (i.e.) if $\frac{ED}{EF} = 6$, then the frog is called a No. 6, the ordinary numbers in use are 8, 9, and 10 for main lines, and 5, 6 and 7 for crowded yards and sidings. The middle frog is a special one, derived from the others by calculation or from a large-scaled plan :

Plate XXVIII.



(1) To calculate the lead from the frog number we have (see Wicksteed, Trans. C. Soc. C. E.) $D\ M$ (Fig. 1.) $= \frac{\text{gauge}}{\sin \alpha}$ or approximately $A\ D = \frac{2 \times \text{gauge}}{\sin \alpha}$ but, for small angles $\frac{1}{\sin \alpha}$ = frog number = N and gauge = g = 4·75 ft., approximately, then frog distance $= 2 . g . N = 9{\cdot}5\ N$ – – – –(A).

(2) *To find the length of the movable rails.*—Offsets to a circle from a tangent vary as the square of the distance from tangent point, and taking gauge as 57 inches and throw as 5 inches we have

$$\frac{\text{slide rails}}{\text{frog distance}} = \sqrt{\frac{5}{57}} = \frac{3}{10} \text{ approx. } (B)$$

also, for stub switch, lead $= \frac{7}{10}$ frog distance (C) which equations give all necessary data for a simple turnout for a stub switch. The frog for a very short distance is straight, and the slide rail is often practically straight, but by using a long rail and spiking the fixed portion, the movable part will bend to a curve.

If split switches are used Fig. 2 will apply, and the movable rail being, necessarily, straight, is from B to C only, is tangent to the circle at B, and is half as long as a stub switch movable rail, also in this case the switch stand is at a different place $K.\ C.$ and we have

$$\text{Switch rail} = \tfrac{1}{2} \times \tfrac{3}{10} = \tfrac{3}{20} \text{ frog distance } (D).$$

$$\text{Lead} = \text{frog distance} - A\ C = \tfrac{17}{20} \text{ frog distance } (E).$$

EXAMPLES.

(a) Stub switch No. 8 frog—
Frog distance $= 8 \times 9{\cdot}5 = 76$ feet by (A).
Slide rail $= \frac{3}{10} \times 76 = 22\frac{8}{10}$ feet by (B).
Lead $= 76 - 22{\cdot}8 = 53\frac{2}{10}$ feet by (C).

(b) Split switch No. 9 frog—
Frog distance $= 9 \times 9{\cdot}5 = 85.5$ feet by (A).
Lead $= \frac{17}{20} \times 85.5 = 72.6$ feet by (E).
Slide rail $= \frac{3}{20} \times 85.5 = 12.9$ feet by (D).

NOTE.—These distances can be varied by a small percentage without affecting the running of the trains.

(3) Middle frog calculations, Fig. 3, Plate XXVIII. First let the two turnouts $AE\ AF$ be of same degree of curve and start from same switch stand, then $\frac{AD}{AC} = \sqrt{\frac{1}{2}}$ or $A\ D = \frac{71}{100}\ A\ C$, which gives us the middle frog distance from the frog distance AC, which equation (A) determines.

Also for small angles the angle of the middle frog will be $2 \times \frac{71}{100}$ frog angle at $C = 1.42$ frog angle C, and the number of the frog will be $\frac{1}{1.42} \times$ frog number $C = {\cdot}703$ frog number C.

Second, let the turnouts be of different sharpness, and let one begin say 6 feet ahead of the other, let the right hand turnout start first and be a No. 8 frog, and the left hand one a No. 10 frog. Call the middle frog distance x.

The two turnout frog distances are
$8 \times 9{\cdot}5 = 76$ feet, and $6 + 10 \times 9{\cdot}5 = 101$ feet.

$$\text{Offset from one tangent to } B = \left(\frac{x}{76}\right)^2 \times 4{\cdot}75 \text{ ft.}$$

$$\text{" \quad " \quad other tangent to } B = \left(\frac{x-6}{95}\right)^2 \times 4{\cdot}75 \text{ ft.}$$

But both offsets added = gauge = 4.75 ft., therefore

$$\left\{\left(\frac{x}{76}\right)^2 + \left(\frac{x-6}{95}\right)^2\right\} 4{\cdot}75 = 4{\cdot}75$$

and solving this quadratic equation we get $x = 61{\cdot}6$ ft. Also we can determine its lateral position by substituting in either of the above equations this value of x, in this case these are 3.13 ft. and 1.62 ft. The angle of the middle frog, in this case, can be calculated thus :

$$\text{Middle frog angle} = \frac{61\ 6}{76} \text{ angle of No. 8 frog} + \frac{55{\cdot}6}{95} \text{ angle of No. 10 frog.}$$

In crowded yards and with split switches these conditions prevail, and many much more intricate calculations are often needed when the turnouts are from curves, and cross other tracks which are also curving, but these can often be best obtained by carefully drawn plans to large scale.

MONTREAL'S TAXATION.

The ratepayers of Montreal find the present taxation of the city none too easy to be borne, and are constantly threatened with increases. The majority of the electors in the city do not feel a serious responsibility in the matter of the city's finances, being chiefly tenants or holders of small properties which bear a very low valuation. They do not therefore check the extravagance and recklessness of the city council, which are flagrant. The only recourse of the more economical portion of the people is to the Legislature at Quebec, many of whose members are not prepared to deal with questions of the magnitude which Montreal's money affairs assume. There has therefore existed hitherto a free expenditure of money, a large part of which never reached the objects for which it was voted, and a constantly growing civic debt for whose payment no means exist if the city is to be maintained in a habitable condition. The city council is constantly looking for fresh subjects for taxation because the limit of the borrowing power has been already reached on the present assessment. At the last session of the Quebec Legislature the city charter was revised and all machinery was expressly made taxable. This has raised a storm among the owners of plants in Montreal, meetings have been held and most vigorous protests made. Some of the leading manufacturers have spoken very plainly on the subject of their removal to more advantageous locations if the tax is imposed. Those who had the charter amendment in charge explain that the city has always had power to tax machinery under the head of "immovables," and the present clause was framed so as to make taxable the wires, rails, etc., of the electric companies which are at present exempt as not being attached to the property of the assessed.

While this explanation shows that the city council has no present intention of placing a tax on manufacturing plants, yet the existence of the clause is a constant menace to the manufacturers at present within the city limits, and a deterrent to others establishing themselves there. It will build up the small towns surrounding the city, and will be an incentive to those bonus-offering towns like Sherbrooke, Que., or Belleville, Ont., to grant inducements to secure the taxed industries. A manufacturer who is heavily taxed on his machinery to raise funds for street paving which is not put down (that is the method in Montreal) is apt to look longingly to towns where there are no taxes on machinery and a large cash bonus is available for buying new plant.

AN ALIEN ENGINEER.

St. Mary's, Ont., had been discussing waterworks systems for two years, but little progress had been made until early last month. Committees of the town council and board of trade had collected some information from other towns, and a public meeting had been held at which some of these had been read. A civil engineer from the United States who happened to be passing through (it is reported in the local papers) stopped off for a few hours, drove round the town with the chief officials and was instructed to prepare plans of a water supply system for the town. The engineer in question is of unquestioned ability, and has constructed some very large works in the United States with a great deal of success, but it would seem almost unfair to Canadians that an alien engineer should be employed upon the mere offer of his services without considering the claims of the many successful members of the profession who have done good work in Canada and depend upon Canadians for the substantial recognition of that work which will enable them to remain in Canada and follow their chosen profession.

INDEX.

The Index for Vol. 6, The Canadian Engineer, is now in course of preparation, and will be mailed to subscribers on application.

ENGINEERING WORKS UNDER GOVERNMENT INSPECTION.

There is a well-grounded prejudice in Canada in favor of the freedom of municipalities in the carrying on of local affairs. We have been accustomed to count our municipal freedom as one of the choicest growths of the freer air of the American continent, and to complain strongly against anything tending to strengthen the central Government at the expense of the outlying centres of authority. But in spite of preconceived notions we must admit that "they do some things better" in Great Britain. We require in Ontario a closer supervision by the Government of public works undertaken by the municipalities.

In Great Britain the Local Government Board has control of all public works such as water supply, sewage disposal works, etc. When a town decides to construct a work the plans are submitted to the Board and are passed upon by engineers whose standing in the profession makes their decisions irreproachable, both morally and scientifically. If the decision is favorable to the proposed work the town is authorized to borrow the necessary funds and carry on the work according to the plans submitted, and the inspectors of the Board see to it that the plans are not departed from nor any work not in accordance with the specifications as passed upon, put in. The consequence of this is that the British local public works are of unrivalled excellence, and the municipal indebtedness is low. In Ontario any clique of aldermen or town councillors who get together may decide upon a public work, talk the citizens into adopting it, hand over its execution to the individual whose arguments appeal most strongly to the aldermanic mind, and so add almost at will to the public debt. It is true that an issue of municipal bonds requires to be approved by the Local Legislature, but it is the issue of bonds that comes in for the criticism of the legislators, not the economical spending of the resulting moneys. Even if the plans were required to be passed by the Private Bills Committee there would be no improvement, for the legislators know very little more engineering than do the aldermen.

A supervisory board of civil and sanitary engineers of the highest standing is needed to act as a check, as does the Local Government Board in Great Britain. We would not then have unsatisfactory works constructed at absurd expense by municipalities unable to carry the resulting debt. This is true in too many cases in Ontario to-day.

SOME INCIDENTAL BENEFITS FROM THE GROWTH OF FORESTS.*

Mr. Chairman and Gentlemen—On considering the true meaning of the title of my subject it has occurred to me that what is the main and what the incidental benefits of forest growth to the community depends largely upon the point of view. The guardian of the public health would probably have no doubt that the principal use of forests was to purify the air by absorbing carbonic acid gas and exhaling oxygen and in regulating the temperature. The scientific agriculturist would be inclined to think that the chief function of a forest was to serve as a windbreak and shelter for farm crops, and assist the subterranean irrigation, while the old-fashioned farmer will be equally certain that the only use of trees is to furnish fuel and fencing, and they should only be grown so long as they are cheaper than substitutes, failing in this they should be cleared off to provide pasture or ploughed fields. The engineer will be inclined to regard trees growing in mass to be chiefly valuable as a regulator of stream flow and a flood preventative, while the artist will look at them mainly from an æsthetic point of view, as making or marring the landscape, according to their presence or absence and thereby contributing to the sum total of human happiness.

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*From a paper read before the Association of Ontario Land Surveyors.

Many land surveyors, I have no doubt, frequently have occasion to regard a forest as an unmitigated nuisance, especially when it is composed of Ilex verticillata, or black alder, and lies in the line of march. As an official of the Government, interested in maintaining the provincial revenues from sources remote from direct taxation, I have to admit that my own point of view is largely a utilitarian one, that regards the forest as a source of wealth to the province and to the people, but I fully recognize the importance of the other, and what I shall call the incidental benefits, benefits so great and so important to the general welfare of the community as to make it desirable that forestry should be an affair of the State rather than of individuals, with whom present financial necessities may cause a sacrifice of future profits and result to the detriment of climatic conditions.

Before going into the matter of the incidental benefits of forest growth, allow me briefly to refer to what I consider the main question from the standpoint of provincial revenue, and the maintenance of the extensive industries dependent upon forest products. The provincial revenue received last year from woods and forests by way of ground rent and timber dues was over $981,000. This represents the production of a large amount of timber, and if we add to this the large quantity of firewood, railway ties, pulpwood and about 375,000,000 feet of timber cut yearly on lands not controlled by the Crown, it will be seen what a very important part in the industrial life of this province is played by our forests and their products. The number of men employed in the woods, on the streams and in the saw-mills, apart altogether from those engaged in other industries dependent in part or wholly upon the forest, runs into the thousands, while the capital employed represents many millions.

It is not necessary for me to go into the many reasons why permanent forest industries must be dependent largely upon State control, that is I think pretty well understood by everybody now-a-days, but I desire to point out what the present forestry policy of the Government means to the future revenue, and the industrial life of the province. The Forest Reserves Act of 1897-8 proposes to set apart areas of non-agricultural lands to be withdrawn from settlement and kept permanently the property of the Crown for the purpose of growing successive crops of timber. If these areas had to be cultivated and planted to young trees, at an expense of about $15 an acre, the amount of money required would be very great, and if the amount thus expended, with interest, were added to the annual cost of care and protection of the young trees, it is doubtful if the resultant crop would show a very large profit on the transaction. True, the crop would be larger than in a forest grown under natural conditions, as was the one we are now harvesting, and a shorter time would be required to enable it to reach a state when it would be profitable to cut it. At the same time the initial expense and annual charges would be so great as to render the project of doubtful financial success on any large scale in this country, where only the more valuable products of the forest have a market value.

Fortunately for us, however, this is not necessary to provide future crops of trees and of the sorts experience has proved to be the most valuable. To do this will require the expenditure of very little money, but more time. I hesitate to make any remarks as to how we are fixed in the former commodity—it is more or less a political subject, on which doctors differ—but we are rich in the latter. How much money we can invest in reforesting without borrowing I will not attempt to say, but we have plenty of time. The nation never dies, or hardly ever, and we are a young nation, with millions of acres of land valuable for growing trees, of little value for any other purpose, so we can afford to wait to allow nature to restore the magnificent forest removed by axe and fire from these lands. And nature is already doing the work, not as evenly as we could wish, nor with a crop of pure white pine, our most valuable tree, but she is doing the work just the same. I had occasion this past summer to examine a tract of several thousand acres that had been lumbered over, and burned over several times. Over this tract I found a vigorous growth of poplar, birch, white pine, red pine, tamarack, cedar, maples and other trees. In some places there was very little pine, but over most of it there is a crop of pine numbering from 200 to 700 trees to the acre and growing very fast. Much of it is now 6 to 9 inches in diameter, and I estimate that in 50 years there will be a very heavy crop of pine ready to cut, not less than 50,000 feet B.M. to the acre. I do not mean that it would be wise to cut that much at that time, but it could be cut.

On much of the abandoned farm lands in New England 50,000 feet to the acre is now standing, and two years ago the Rathbun Co. cut 100,000 feet to the acre over quite a tract in Grinsthorpe. I mention this to show that my estimate is not excessive. The stumpage value of that pine 50 years from now will be worth not less than $4 per M, and is likely to be worth more. At this figure the pine timber on much of this land fifty years from now, if protected and cared for, will be worth $200 per acre, which represents a present cash value at 3 per cent. compound, of $45.62 an acre, and this land is generally considered of no value.

The main benefit to be expected from these reserves consists in the provincial revenue, and the maintenance of industries dependent on them, but in addition to this the incidental advantages from the presence of these masses of trees are of vast importance to the people of this country. Concerning these factors in forest value there is room for considerable diversity of opinion, and this diversity exists. It is claimed by some forestry advocates that forests materially affect the rainfall, while on the other hand, it is claimed that it is not so, but that the rainfall affects the forests. While there can be no doubt of rainfall affecting the forests, it is not equally certain that the presence of forests influences the amount of rainfall. It is a case of not proven, although to my mind the evidence mainly goes to show that if the total rainfall is not influenced by tree growth its distribution is. We know that trees take up immense quantities of water from the soil and transpire most of it through the leaves. The moisture thus transpired from a large hardwood forest is very large, though difficult to estimate accurately, as the amount varies with the thickness and number of the leaves, amount of water in the soil and other conditions. A conservative estimate is made by F. B. Hohnel, a German scientist, of a fifty or sixty-year old beech forest for the season of growth at 1,972,000 lbs. or 986 tons of water per acre. Some authorities make the amount much larger than this, but in any event there is sufficient to lead one to believe that the atmosphere immediately above a forest must be so charged with moisture as to hasten precipitation in clouds that may come in contact with it. That forests exercise a beneficial influence on the climate of the neighborhood there can be no doubt. The temperature of the air in the forest is cooler during the day and warmer during the night than in the open field. Consequently air currents are set in motion by this difference in temperature, cooler currents coming from the forest during the day in the lower strata and warmer air during the night from the upper strata, thus equalizing the temperature and increasing the humidity of the air. This is aside altogether from the mere windbreak action of the forest, which is of considerable importance.

The aspect of forest growth most likely to appeal to the members of this association is its effect as a regulator of our water supplies, and a factor in flood prevention. Even here there seems to be a difference of opinion, and a Western States writer a short time ago claimed that the presence of forests in the mountains prevented the snow from drifting into immense banks and then gradually thawing all summer, keeping up a constant supply of water for the streams. Without disputing this statement—for it cannot possibly apply to our own province, which is not mountainous—I may state as an accepted fact that the main factor in our great wealth in water powers and navigable waters are the great forests. At the risk of repeating what you may already know better than I, I desire to point out some ways in which the forests serve to regulate the flow of streams and prevent alternate flood and drought. Speaking generally the steam flow can only reach a percentage of the rainfall in the catchment basin. If the water does not fall either as rain or snow there can be no streams; but granted a certain precipitation during the year it may be gradually given off to the streams, making them reasonably constant in volume, or it may run off quickly, causing a flood and subsequent drought. Our streams are fed in two ways, by underground springs, and by the run off from the surface of rain or melted snow. Springs occur generally where a layer of porous sand or gravel lies between an impenetrable subsoil and the surface soil. The rain water runs under this top soil through the sand or gravel, and as it cannot penetrate the subsoil it is forced out through an opening in the top soil and goes to add to the volume of the nearest stream. It will readily be seen that a larger quantity of water will reach the grave layer if the surface is covered with forest than would be the case in the open field, as most of it would run off the surface after rain, in the latter case instead of soaking into the soil. Most of us have known of springs that have become dried up in the summer, that years ago before the woods had been removed were perennial.

In the same way the forest serves to regulate the water running from the surface into the streams. Concerning the extent of this action of the forest a great deal has been written pro and con, and volumes of figures have been compiled to show that the removal of the forest had little or nothing to do with stream flow. At the same time I think we are all pretty well convinced that Captain Eads, the famous engineer, was right when he remarked concerning the building of the jetties at the mouth of the Mississippi River, that he was working at the wrong end of the stream. The very nature of a forest floor covered with small twigs, leaves and sponge-like soil, indicate the mechanical action that dams the water and allows it to run off slowly. Branches die and fall to the ground. Trees do likewise and in falling across something would form dams and create small reservoirs of water against the time when it would be needed. The sorts of trees also form conductors that allow the water to penetrate the subsoil deeply, and add to the subterranean supply. Remove these forests and the rainfall rushes off to the streams, which are soon in flood and soon dry up. The snow exposed to the full force of the wind and sun follows the same course, and large sums are being spent all over the continent to prevent the disastrous floods that now cause so much damage and loss of life, but which were not known in the earlier days when this was really a "wooden country."

At Brantford, I believe, they are spending a large sum of money to prevent the annual flood of the Grand River doing so much damage. It is worth noting that the county of Brant has only about 7 per cent. of its total area classed as woodland, and of this much is not tree forest land, but is pastured and the soil beaten hard. Most of you know something of the vagaries of the river at Belleville, which nearly every spring causes anxiety as to the amount of damage it is likely to do in flood, and in summer is so dry as to cause the remark by a traveler who saw it last fall from a Grand Trunk car that "it looked like a first-rate place to put a river in."

A concrete case of the effect of forest denudation on stream flow has been furnished by W. C. Caldwell, M.L.A. Mr. Caldwell is a lumberman and a mill owner, and as his business interests were affected, he made careful notes of the occurrence in his diary at the time. The watershed of the Clyde River was swept by successive fires in 1875-6-7, a large territory being affected. The water supply was gradually affected from 1880 to 1885. From 1885 to 1892 the flow of water was so reduced that in 1886-7-8-9 and 90 the mills on the Clyde were short of water in August and September, something unknown until that time. In the meantime the new crop of poplar, birch, etc., had reached quite a size, and in 1890 began to affect the water supply and restore the evenness of flow. Since 1893 there has been an abundant supply of water, and Mr. Caldwell has no doubt it is due to the effect of the new forest that has followed the fires. Failing this new forest a constant supply of water could only have been secured by a costly system of impounding reservoirs.

LITERARY NOTES.

The annual report of the Department of Mines, Nova Scotia, for the year ending Sept. 30th, 1898, contains 100 pages of facts and figures about the progress of mining in Canada's farthest East. Extracts from the report will be found on another page.

Canadian Hand-Book of Steam and Electricity is a volume of 150 pages in brown cloth, published by the C. H. Mortimer Co., Ltd., Toronto, contains a mass of valuable information, much of which is in tabular form and convenient for reference. A large portion of the work is of such an elementary character as to give it special value for beginners.

Accounts of the City of Charlottetown, P.E.I., and Annual Reports of the several departments of the City Government for the year ending the 31st Dec , 1898, embodies the report of the city engineer, Freeman C. Coffin, upon the system of sewage disposal for the city now being installed. We hope to refer to the special features of this system at a later date.

The Annual Report of the City Engineer of Hamilton, Ont., for 1898, contains among other interesting matter a large colored map, showing the proposed changes in the water distribution system. The expenditure on public works in the past year was $204,861.36. Full page illustrations are given of the new pumping station, the filtering basin, boiler room of the main pumping station, etc.

The Canadian Magazine for April contains an interesting chapter of Miss Wood's story "A Daughter of Witches" and a pleasant variety of short stories, together with the usual poetry. Judge Ermatinger continues his historical sketch of the Michillimackinac. It is unfortunate that this number, however, retains the dime magazine standard by publishing a variety of uninteresting pictures of more or less uninteresting theatrical persons.

The special Easter number of the Ironmonger issued March 25th, 1899, is one of the most successful special numbers that trade journalism has produced, The lithographed cover is a pleasing introduction to the three hundred and eighty pages of illustrated advertisements and general reading.

The Universal Electrical Directory (J. A. Berley's) for 1899' which is the eighteenth year of publication, contains in its 1,250 pages an amazing mass of most useful information. The index alone, to the classified trades, occupies four pages, which is a criterion of the thoroughness with which the ground is covered. It is difficult to think of an electrical trade question which cannot be answered by the aid of this well-named Universal Electrical Directory.

We have received A. S. Lovendal's Dictionnaire Technique Francais-Anglais des Outils et Ustensiles Employés dans les Metiers manuels, La Petite Industrie, La Ménage, etc. This is a most valuable dictionary for anyone who has to do in any way with the arts or trades among our French-speaking fellow citizens. The lists are most complete and are so arranged as to be most conveniently referred to, as not only are the different tools and apparatus listed alphabetically, but also each art or trade has grouped under it, as a heading, all the tools, etc., which naturally fall there.

The series of papers by Cecil B. Smith, Ma. E., which appeared in THE CANADIAN ENGINEER during the past two years have now been issued in book form under the title "Railway Engineering." There are many standard works written upon various phases of railroad construction, the merits of which are universally recognized, such as "Wellington's Theory of Location" and "Foster's Wooden Trestle Bridges," but Mr. Smith's work is the only general discussion of the entire subject that has recently been published and the work is therefore very welcome, especially to those who may wish to acquire a general knowledge of the subject before commencing a special study of any one of its details. The title "Railway Construction" would perhaps be more appropriate than that of "Railway Engineering" as the book does not deal with the important branches of track maintenance and operation. Mr. Smith's long and honorable professional career amply qualifies him to write as an authority upon his chosen theme, for he has been prominent in the locating and constructing staff of the Northern Pacific Junction, Niagara Central, Charleston, Cincinnati and Chicago, Roanoke and Southern, Baltimore and Ohio, and Canadian Pacific Railways, and had ample opportunity during his connection with McGill University to thoroughly study the theory and literature of railroading. His work therefore presents to the reader a concise and thorough description of the engineering side of railroad construction, and in detail is as follows: Chapter I. is devoted to railroad statistics, dealing more especially with those of Canada, and commenting particularly upon the maxims of railroading and the considerations technical, political and local which must be taken into account when studying any proposed line. In Chapter II. train resistances and their effect upon the cost of transportation are discussed, the methods introduced by A. M. Wellington in his "Theory of Location" being closely followed. This chapter is perhaps the most valuable in the book, for to-day no locating engineer can be considered as properly qualified who is not fully aware of the financial effects of grades and curvature. Chapter III. contains a brief reference to the use of circular curves and a clear exposition of vertical and transition curves. These latter may still be classified as recently introduced, for their use is by no means general to-day and the realization of their importance dates only from the first scientific study of the theory of location. The simple methods of calculation that are recommended nullify the objections on the ground of intricacy that are so often urged against them. In Chapter IV. the reader gets the benefit of Mr. Smith's wide experience in reconnaissance and field work, and the many practical hints given are of great value. Chapter V. is devoted to construction and treats of those structures that are usually under the superintendence of the resident engineer. It is plentifully illustrated with cuts of the standard plans of the various railroads with which the author has been connected and concludes with some very pertinent advice upon classification and estimation. Chapter VI. is a most unusual and interesting addition and contains a careful resumé of those clauses of the Railway Act that are of special importance to engineers. A brief second part upon track material concludes the work, but the collection of diagrams for the rough estimation of timber and masonry quantities from the profile are worthy of especial mention from their particular usefulness in the comparative study of locations. While the book as a whole is very welcome, dealing as it does with the entire field of the construction engineer, the chapters upon train resistances and railway law deserve the most especial commendation, because many of our engineers have simply grown into their profession and are ignorant of the great forces, natural and political, that control our common carriers. It is only to be regretted that Mr. Smith has not seen fit to discuss this interesting subject at greater length, for there is room at present for a successor to the once standard work of G. L. Vose; but as it is, it is to be heartily recommended to all who desire a clear introduction to the art of railroad building. Railway Engineering, Cecil B. Smith, Ma. E. Cloth, 200 pages, profusely illustrated. Biggar, Samuel & Co., Publishers. $1.50.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports into Canada from Great Britain of interest to the metal trades for the month of February and the two months to February, 1898 and 1899:—

	Month of February,		Two Months to February,	
	1898.	1899.	1898.	1899.
Hardware	£1,629	£1,116	£3,333	£2,654
Cutlery	3,283	3,055	6,612	7,820
Pig iron	1,348	401	1,852	762
Bar, etc.	1,212	801	1,412	1,246
Railroad	6,872	..	6,922	..
Hoops, sheets, etc.	1,939	1,618	2,753	1,743
Galvanized sheets	542	332	2,518	820
Tin plates	6,586	5,862	18,515	11,547
Cast, wrought, etc., iron	1,998	1,443	3,571	2,440
Old (for re-manufacture)	80	..	80	..
Steel	6,106	1,919	10,627	5,689
Lead	594	133	1,518	1,022
Tin, unwrought	619	118	1,920	2,633
Alkali	1,383	853	2,884	2,396
Cement	1,389	35	1,874	248

SUMMARY OF THE MINERAL PRODUCTION OF CANADA IN 1898.

The following figures have been submitted by the Geological Survey of Canada to the Government, and are subject to revision:

Product.	Quantity. (*a*)	Value. (*a*)
Metallic—		
Copper (fine, in ore, etc.) (*b*) lbs.	17,951,421	$ 2,159,556
Gold, Yukon district*	....	$10,000,000
Gold, all other	....	3,700,000
Iron ore, tons	58,161	152,510
Lead (fine, in ore, etc.) (*c*) lbs.	31,915,319	1,206,399
Nickel (fine, in ore, etc.) (*d*) lbs.	5,517,690	1,820,838
Silver, (fine, in ore, etc.) (*e*) ounces	4,434,085	2,583,298
Total metallic	....	$21,622,,601
Non-Metallic—		
Asbestus and asbestic, tons	23,785	486,227
Chromite, tons	2,021	24,252
Coal, tons	4,172,655	8,227,958
*Coke (*f*) tons	72,444	219,200
Felspar, tons	2,500	6,250
*Fire clay, tons	2,170	5,000
Graphite, tons	....	11,098
Grindstones, tons	....	39,465
Gypsum, tons	219,256	230,440
Limestone for flux, tons	33,913	31,153
Manganese ore, tons	50	1,600
Mica,	....	117,598
Mineral pigments—		
Baryta, tons	1,070	5,258
Ochres, tons	2,341	18,600
*Mineral water	....	155,000
Moulding sand, tons	10,572	21,038
*Natural gas (*g*)	....	320,000
Petroleum (*h*) bbls	700,790	981,106
Phosphate (apatite), tons	733	3,665
Pyrites, tons	32,218	128,872
Salt, tons	57,142	248,639
Structural materials and clay products—		
Cement, natural rock, bbls	87,125	73,412
Cement, Portland, bbls	163,084	324,168
Flagstones	....	4,250
Granite	....	73,573
*Pottery	....	135,000

Sewer pipe	....	166,421
Slate	....	40,791
Terra cotta	....	167,902
Tripolite, tons	1,017	16,660
Building material, including bricks, building stone, lime, sands and gravels and tiles (estimated as for previous year)	....	3,600,000
Total structural materials and clay products	....	4,602,177
All other non-metallic	....	11,282,419
Total non-metallic	....	15,884,596
Total metallic	....	21,622,601
Estimated value of mineral products not returned	....	250,000
1898 total	....	37,757,197
1897 total	....	28,661,430
1896 total	....	22,584,513
1895 total	....	20,758,450
1894 total	....	19,933,857
1893 total	....	20,035,082
1892 total	....	16,628,417
1891 total	....	18,976,616
1890 total	....	16,763,353
1889 total	....	14,013,913
1888 total	....	12,518,894
1887 total	....	11,321,331
1886 total	....	10,221,255

*Partly estimated.

(*a*) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(*b* Copper contents of ore, matte, etc., at 12.03 cents per lb.

(*c*) Lead contents of ores, etc., at 3.78 cents per lb.

(*d*) Nickel contents of ore, matte, etc., at 33 cents per lb.

(*e*) Silver contents of ore at 58.26 cents per oz.

(*f*) Oven coke, all the production of Nova Scotia and British Columbia.

(*g*) Gross return from sale of gas.

(*h*) Calculated from inspection returns at 100 gals. crude to 42 refined oil, and computed at $1.40 per bbl. of 35 imp. gals. The barrel of refined oil is assumed to contain 42 imp. gals.

In studying the figures given in the above general table, many interesting and gratifying features will be noticed. In the grand total an increase is shown of over $9,000,000 or nearly 32 per cent. as compared with 1897. This is a still larger proportional increase than that of 1897 over 1896 which amounted to nearly 27 per cent. Compared with 1886, the first year for which statistics were issued, we find an increase in the value of mineral products in thirteen years of nearly 270 per cent. When it is remembered that during the same period the increase in the population has been only about 14 per cent., it will be evident that the proportional importance of the mining industry to the country is very much greater than it was at the beginning of the period dealt with. Thus the per capita value of the mineral production of the country has increased from about $2.20 to $7.20. Whilst these large increases of late years have of course been partly due to the discovery and working of the rich gold-placers of the Yukon, other important mineral industries have also contributed to them, and there is every reason to expect a continued rapid growth in many of them for some years to come, especially as the province of British Columbia continues to develop. The following table shows the principal changes in the production and values for the year 1898 as compared with the revised figures for 1897:

	—Quantity—		—Value—	
Product.	Increase. Per cent.	Decrease. Per cent.	Increase. Per cent.	Decrease. Per cent.
Metallic—				
Copper	34.96	.....	43.81	.....
Gold	.....	.....	127.31	.....
Iron ore	14.70	.....	17.05	.....
Lead	.....	18.20	.....	13.63
Nickel	38.02	.....	30.14	.....
Silver	.....	20.23	.....	22.27
Non-Metallic—				
Asbestus and asbestic	.....	21.87	9.17	.....
Coal	10.21	.....	12.66	.....
Gypsum	.....	8.52	.....	5.76
Natural gas	.....	.....	.....	1.80
Petroleum	.....	1.28	.....	3.00
Cement	21.93	.....	44.43	.....

It will be observed that most of the large increase in the total is to be credited to the metals, gold, copper, nickel, the non-metallic materials, coal, asbestus and cement also contributing. Beginning with the most important, the increases in these products were as follows, viz.: Gold, about $7,673,000; coal, over $924,000; copper, nearly $658,000; nickel, nearly $422,000; asbestus, iron ore and cement aggregating about $185,000. Of the gold output the main feature was the very large increase in that of the Yukon. This accounts for $7,500,000 of the enlargement, which is three times as great an estimated output as that for last year. With the exception of the gold washings of the Saskatchewan River in the Northwest Territories, there were also increases in all the other districts of the Dominion. There were increased outputs of coal in all the different districts. In copper the largest increase was in Ontario, which amounted to over 50 per cent. of the previous year's output. British Columbia showed also a considerable enlargement, whilst in Quebec a small falling off was apparent. A rise in the price of the metal makes the proportional increase in value greater than that for quantity. In nickel, the increase in the quantity is greater than that in the value, owing to a fall in the average price of the metal for the year.

The falling away in the production of both lead and silver is, in the former case, partly offset by the rise in the average price, whilst in the latter case a lower price for the year has aggravated the proportional decrease in the value as compared with the quantity. Whilst there was a decrease in the actual quantity of the product of the asbestus mines of Quebec, the value shows a large percentage increase, which is explained by the lesser proportion of asbestic and low grade fiber in the output. The proportional contributions of the chief products to the grand total of value are set forth in the following table both for 1897 and 1898:

PRODUCT AND PER CENT. OF TOTAL PRODUCTION

	1897.		1898.
Coal	26.87	Gold	36.28
Gold	21.02	Coal	21.79
Building material	12.56	Building material	9.53
Silver	11.59	Silver	6.84
Copper	5.24	Copper	5.72
Nickel	4.88	Nickel	4.82
Lead	4.87	Lead	3.19
Petroleum	3.53	Petroleum	2.60
Asbestus	1.55	Asbestus	1.29
Natural gas	1.14	Cement	1.05
Cement	96	Natural gas	85
Gypsum	85	Salt	66
Salt	79	Gypsum	61
Coke	62	Coke	58

With the exception of the transposition of the positions of gold and coal, of natural gas and cement, and of gypsum and salt, the items stand in the same order as before. The feature mainly noticeable is of course the assumption of the first place by gold, and its large predominance over the rest. To this is largely due the fact that the metallic minerals as a class contributed in 1898 over 57 per cent. of the whole, as compared with about 48 per cent. last year. The structural materials amounted to about 12 per cent., and the other non-metallic minerals to about 30 per cent.

BOSTON SEWAGE OUTFALL.

BY CHARLES E. TROUT.

For THE CANADIAN ENGINEER.

More than one-half the sewage of Boston and vicinity is discharged into tide water at Moon Island, about six miles from the main water front of the city. To reach this point the sewage flows by gravity to a pumping station on the harbor front near Moon Island, where it is raised about thirty-five feet and forced through a tunnel under an arm of the harbor to the outfall works. These consist of a storage reservoir, together with the necessary gate houses and machinery for filling and discharging. The function of the reservoir is to store the sewage while the tide is flowing in and discharge it after the tide has turned, when the strong current carries it out to sea. The reservoir is composed of four distinct basins, so arranged that one may be kept empty for any purpose, as cleaning or repairs, while the others are in use. The four basins are of nearly equal capacity and the division walls between the basins are of rubble on concrete foundation. Where the foundation rests on gravel or other pervious material a line of tongued and grooved sheet piling is driven into the clay underlying such material. As a further precaution against water passing under the division walls and the bursting of the reservoir floor by springs, a line of drain pipe, with open joints, is laid on either side of each division wall, and beneath the floor of the basin. These drains discharge outside the reservoir. Thus, water accumulating beneath the floor finds free access to the drains, and is carried safely outside the reservoir. A safety valve, opening into the reservoir is provided on each drain to relieve an excess of pressure below the floor in event of a drain being choked. The floor of the reservoir is of concrete nine inches thick, and is shaped in alternate gutters and ridges, the width centre to centre of ridges being twenty feet. Set in the ridges at intervals of thirty feet are blocks of granite, three feet square and eighteen inches deep, to be used as pier stones in case it should ever be necessary to roof the reservoir.

The arrangements by means of which the reservoir is filled and emptied could best be illustrated from a figure. Across the lower end of the reservoir runs the outfall sewer, which brings the sewage from the city to the works. Immediately below it are the discharge sewers, which carry the sewage from the reservoir out to sea. These are all of brick and backed with rubble masonry. Between the sewers and the reservoir is what is known as the six foot gallery which serves as a foundation for the gate house above, and as a protection for the gates from frost. It is divided by the division walls of the reservoir and four partition walls, one opposite the centre of each basin, into eight compartments. In both the outfall and discharge sewers, on the side next the reservoirs, are twenty gate openings, each three by four feet. Only half of these, eight in the outfall and twelve in the discharge sewers, are at present in use. The rest are bricked up until the increased amount of sewage renders them necessary. The gates with their frames are of cast iron, with bearing surfaces of composition. Both gates and frames are single castings, which are grooved to receive the strips of composition for valve faces and gate rests. The grooves are worked out by machine tools and the strips are riveted in place with composition rivets. The gates are pressed tight by adjustable gibs, bearing on inclined planes, cast on the frames. The gates are raised by lifting rods and screws, connected with suitable gearing above the floor of the gate house. The clutches for each gate are thrown in by a hand lever, and may be thrown out by hand or by the gate itself on reaching either end of its course. The gearing is driven by a main line of shafting, running the full length of the gate-house—575 feet—and varying in diameter from three and one-half to two and one-half inches. The power to operate the gates and for other purposes is furnished by a turbine wheel installed at the lower end of the outfall sewer, and driven by the sewage. The wheel pit drains into the discharge sewers. Ample power is furnished by the turbine for operating the gates, pumping and running other machinery about the works, at no expense for maintenance, and with no attention beyond opening and closing the gates leading to the wheel pit.

The reservoir has a capacity of about 25,000,000 gallons. Under ordinary conditions it will fill in about ten hours. In time of storm, however, the reservoir is not large enough to store the extraordinary quantities of sewage received, and it is frequently necessary to begin discharging before the turn of the tide. The frequency of this early discharge is constantly increasing with increasing population and water consumption, and might in time give cause for complaint to property owners on the water front of the city. The builders of the present reservoir foresaw the necessity of increasing its capacity in the future, and they so located and carried on the work that such an extension could be easily carried out by increasing the length of the basins. Such works are now in progress. The length and capacity of the basins will be doubled.

The method of discharging, flushing and filling the reservoir is as follows: An hour or so after high water, the water in the harbor being then about the height of the bottom of the reservoir, the gate leading to the wheel pit is opened and water is admitted to turbine. The shafting in the gate house starts and it is possible to raise or lower any gate by throwing its operating machinery into gear. First, the gates leading from the outfall sewer are closed, then those leading to the discharge sewers are opened. Under ordinary conditions the reservoir is empty in less than an hour. A deposit of slime remains in the bottom of the reservoir, generally quite thin, but in considerable quantities after a storm. To remove this the reservoir is flushed by the sewage stored in the outfall sewer. The openings from the reservoir to the six-foot gallery, excepting those next the side and division walls, are provided with gates hinged at the top and swinging into the six-foot gallery. Thus, while the basins discharge at all the openings they fill only from the two extreme openings. As soon as a basin is empty the lower gates at one side are closed and the upper gate on the same side opened wide. The sewage rushes in, filling one compartment of the six-foot gallery, and rushing into the basin by the one opening not provided with a gate, it flows up the gutter opposite that opening, and at the same time it spreads out over the ridges washing the slime into the gutters. As soon as enough sewage has entered, the upper gate is closed and the lower ones opened. The flush is drawn into the discharge sewers, where it is held till the next discharge, in order that, being the foulest of the discharge it may have an early start and be carried well out to sea. The flushing is done alternately from opposite sides of the basin. This method works well excepting that it will not clean the back corners of the basins of heavy materials, and a deposit of gravel, sand and sludge collects there which has to be occasionally shovelled out. Once a month or so the reservoir walls are washed by a fire stream furnished by a power pump driven by the turbine. Salt water from the harbor is used in this washing.

As it is not expected that the present method of flushing will be effective when the basins are doubled in length, a method has been devised by means of which the flushing will be done from the upper end. A large sewer will be built from the outfall around the upper end of the reservoir. On this sewer will be four gate houses, one opposite the centre of each basin, through which sewage can be admitted in sufficient quantities to thoroughly flush the basin. A system of stop planks will be provided to distribute the sewage over the width of the basin. The gates in these gate houses will be operated by compressed air pistons with valves operated by electricity. The compresser and perhaps a dynamo as well, will be operated by the turbine.

In winter scarcely any odor is noticed from the basins, but in hot weather an offensive smell arises at times. However, as no one lives nearer than the main land, a mile away, this is not a serious matter. Generally the tidal currents carry the sewage away from all inhabited places, but occasional complaints are heard from summer resorts along the coast. These are neither very earnestly made nor very seriously taken, and are probably due to a readiness to attribute the consequences of local carelessness to a distant cause. At the worst, however, the works quite fulfil their object in minimizing the nuisance caused by the sewage of the district they serve.

METALLURGICAL MACHINERY.*

BY A. C. M'CALLUM, M.E., PETERBORO, ONT.

In the matter of the design of metallurgical machinery it must be admitted, with reference to rolls, crushers, stamps and other machines employed in the reduction of ores, one is almost led to believe that they are not susceptible of as exact an analysis as a bridge for example. In the following remarks it is purported to deal with the most familiar machines employed by mining engineers, such for instance as crushers, rolls, stamps and feeders. To deal with them from the designer's point is my purpose.

Considering in the first place crushers, the introductory remarks anent them are applicable to most all of the other machines mentioned. It will readily be admitted that many designs of crushers show by the distribution of the material within them, that the designer neglected to take advantage of a method of analysis commonly employed by designers of bridges and other large structures, a system of analyzing quite applicable to mining machinery, namely by that of graphics. The construction of a graphic diagram of stresses within any machine under design is most essential; as upon it the designer elaborates his working drawing. The benefits to be derived from such a process of designing cannot be overestimated, it impresses upon the designer an intimate and exact knowledge of the acting forces and their distribution throughout the parts of the machine in the process of design; there may be many problems which are extremely complex and frequently unsolvable; it is necessary however, to possess definite knowledge of the resistance of the materials employed in the construction of the machine to those complex forces.

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*From a paper read before the Canadian Mining Institute.

It has been sometimes remarked that skill and good workmanship are not essential features in the make-up of mining machinery, but the idea is false, more plants built for the purpose of ore reduction have been failures, due in large measure to the fact that the enterprise was handicapped by machinery ill adapted for the purpose. It is to be much regretted that many engineers in the purchase of mining machinery estimate the superiority of the machines to be purchased by the dead weight, regardless of how the material is utilized and distributed. Discussion will not alone settle the question finally in all cases without elaborate and unprejudiced experimental work. Most careful investigation is necessary in many instances to discriminate between real improvement and the impractical. The sine qua non of good machine design, from a structural point of view, is the presence of sufficient material of the proper kind, in the right place. There are many types of crushers upon the market, and there is no doubt that the majority of them were originally intended for breaking road ballast. The demand within recent years for crushing machinery in mining regions is primarily the cause of their being advanced to the front as crushing and pulverizing machines. There is no doubt that the "Blake" type of crusher stands pre-eminently for service and has been generally adjudged the most efficient and economical in use; perhaps the reasons most readily advanced for such, lies in the fact that for a given capacity the first cost is less, the cost for repairs is also less, and they are idle for repairs much less of the time. The "Blake" type of crusher has developed few changes from the original design. The first type of "Blake" crushers had the crushing jaw pivoted at the bottom, as at present in general use the jaw is pivoted at the upper end. It is a matter of choice, to do a given amount of work by either of the types of machine; one with the working jaw pivoted above, the other below. For the jaw pivoted at the bottom, the plea is used that a more uniform product is obtained, and that finer crushing, when that is desirable, can be secured. The concurrence of preference however if gauged by use, is in favor of the modern "Blake" design with overhung jaws, when that type of crusher is chosen.

A general summary of crushers upon the market if analyzed would reveal the important fact of a want of harmony amongst the various types of similar dimensions. The dimensions of the openings are not called in question, but like pieces within different makes of crushers. So far as the openings of the jaws are concerned, those dimensions are not by any means arbitrary, but have been fixed by experience. Quartz generally breaking in sizes which can be suitably crushed by ore breakers of such standard dimensions as 10x7 in., 15x9 in., 20x10 in. Mining engineers in charge of plants are well acquainted with the many faults developed in crushers under their care, broken frames, pitmans, jaws and other parts are known. What then are requirements of a good crusher ?

In order that the crusher shall run easily, cool, and prove serviceable, it is requisite that all of the journals be in correct alignment one with the other. Rigidity, strength and sufficient weight must be found in the frame, so that the vibrations created while crushing may become absorbed. This must be advanced as the reason for the failure of the many types of steel plate frames, they easily yield to the strains within the machine, thus causing the working parts to become out of proper relation one with the other, and resulting in heating, and running hard. According to the nature of the product to be crushed, we must have a certain direction of stroke, length of stroke, and relative angle in the position of jaws, and to procure those conditions various means are employed, which methods are well known to mining men. But it has appeared to the writer that simplicity of construction may be secured by abolishing from the type of crusher under consideration, the wedge block so common, and employing other means of adjustment, for instance by means of the toggles. Change of toggles can be effected as readily as by means of the adjustable wedge. The movement required can then be made by rearrangement of the toggles. The machine being provided with a set of toggles giving the requisite maximum and minimum openings. It is necessary that the shaft supporting the jaw should be securely fastened to the jaw, not by means of set screws, a preferable method of fastening is that of the gib and key. The jaw shaft is then required to move in the bearings of the machine. This overcomes the pounding and jumping due to lost motion, which readily develops when the jaw moves upon the shaft. The caps of the bearings can then be tightened whenever wear renders it necessary. Within the pitman much trouble is often created, perhaps no other feature within the make-up of the pitman creates more trouble than the adjustable devices provided to take up wear, when the eccentric shaft has worn out of round, due to the strain upon it being constantly in one direction.

Fly-wheels as commonly fastened to crushers are at fault. By employing them as a means to prevent serious injury to the working parts of the machine, owing to sledge hammer heads falling into the jaws, or other causes, we may so fasten the fly-wheel upon the shaft that in case of accident the belt may slip and the crusher stop while the fly-wheels exhaust their motion. We may use taper keys.

The reduction of granulation of coarse particles of ore by means of rolls, has been given much consideration during the past few years. The variety of crushing rolls are many and various in type and construction. Machines for this class of work have been largely involved by American engineers, and proof of their superiority is to be found in the fact of their having gained admission to almost every large metallurgical work throughout the world. Notwithstanding the many changes that have been made during past years in all the various designs known to us, no special one has met with general approval. The most potent change has been in the adoption of steel as the material for use in the construction of the shells. The construction of the frame in one piece, having sufficient weight and strength to absorb the vibrations set up within the machine, and closer study has been given to the matter of the strains with the structure. Marked improvement over the older forms of crushing rolls has been made in the design of journal bearings, methods of lubrication, and the facilities for dismantling the machine if required. Considerable ingenuity has been displayed to obtain complete and satisfactory methods for keeping the lateral adjustment of the rolls correct. The adoption of springs for that of levers and dead weights within the machine to give crushing power to the rolls is an important improvement, affording as it does, a much more uniform product. The adoption of some form of housing obviates the wasteful and disagreeable nuisance of dust usually found around rolls employed in dry crushing, and length of life to the machine is ensured. The most marked change within recent years has been along the line of increased peripheral speed, by the employment of rolls of larger diameters, and narrower faces. The results being decrease of journal friction, increase of crushing surface, and reduction of spring pressures. Those changes are undoubtedly the direction in which modern practice is tending. Peripheral speeds of 600 to 1,000 feet per minute are now found to be practicable, but this change in speed has also brought about many of the improvements already mentioned. The aggregate spring pressure is now greater, ranging from 2 to 3 tons per inch width of face of roll shells. Change has also been made from gears to belts, proving a much more preferable method of driving. In the earlier form of rolls, the spring pressure was carried along the main tension bolts, making it a matter of considerable labor to adjust the rolls. The method now in use consists of enclosing the whole nest of springs between two washers, and constructing them so that each nest forms a complete washer of an inelastic nature, until such time when the maximum pressure is reached, further compression taking place, relief is afforded to the rolls by the deflection of the springs. Chilled iron shells in all probability will be displaced by steel shells. In the design of rolls presented all the above mentioned improvements have been embodied, simplicity of construction, fewness of parts, and interchangeability is to be found. The hopper underneath the rolls is constructed in such a manner that no pockets are permitted, all four sides declining towards the bottom at an angle of 45 degrees, thus affording cleanliness at all times within the machine. The matter of sliding versus swing bearings for the removable roll, was decided in favor of swinging roll bearings. The wearing surfaces become reduced by means of their adoption. Any wear about the bearing surfaces of sliding roll bearings is an evil which may result in damage to the frame ot the machine; it is easier to maintain the alignment of the swinging bearing in the sliding type of bearing. In design for rolls, a feature worthy of consideration is that of the disposition of the bolts employed for the purpose of bolting the machine together, it is a desirable feature to have as few as possible, and so arranged that should they by any means become loose, they may not fall within the machine. The use of common nuts is not desirable, and recourse must be made to lock nuts or elastic nuts; this provision prevents the bolts becoming loose, and may help to preserve the machine from injury.

The construction of mortars will always prove interesting to mining men. The sectional mortar contains a feature new to the writer. It is usual in the construction of sectional mortars to make the ends in two pieces. In this particular mortar, to overcome making the ends in the above way, they were carefully designed (not to exceed 350 lbs. in weight) and in making the ends of cast steel the joint usually found was eliminated, and considerable strength has been thus added. The drawing shows the construction clearly. This type of mortar was designed for the Ben d'Or Mine, Bridge River, B.C. In the 3-stamp double discharge mortar, the lower guides of the battery are to be found in the upper part of the mortar, water supply is carried to and around to each of the heads. The pulp from back screen running through a channel cored in base of mortar and joining to that of the channel from front screen is then carried by a pipe and distributed over the amalgam table. This type of mortar was designed for the Oro Fino Mill of Fairview district, B. C. Amongst designers of mining machinery the ore feeder has been taken in hand, and it doubtless has been observed in recent designs presented for public favor that of the suspended type shows many marks of improvement in design, utility and simplicity of construction. The marked changes in this feeder are to be seen in the abolition of the adjustable mechanism to the feed lever, the lever adjustment being made by means of a collar on the stamp stem, or by the bumping rod. Gears are not employed at all, thus resulting in quiet running. One could, perhaps, make extended remarks with regard to other machines in process of design and manufacture. I feel I have not done justice to the subject, it is much too wide for a single paper. Papers on metallurgical machines to be of real benefit to the Institute should be divided into sections, treating of the design and dynamics of each machine in separate papers. Should it be the pleasure of the Institute I would willingly contribute my small quota. Publication of data thus collected may not be considered of much moment by the busy outer world, but it clarifies the writer's ideas, and brings into compact form and small bulk, a large amount of knowledge otherwise unattainable. This information adds much to the making of the routine work of the profession more productive and pleasurable.

THE NOVA SCOTIA COAL TRADE.

The following returns of Nova Scotia coal sold during the year 1898, shown in the report of the Department of Mines, Nova Scotia, in comparison with those of 1897, are as follows:

	1897.	1898.
Nova Scotia	641,308	667,252
New Brunswick	242,043	266,789
P. E. Island	62,032	93,241
Newfoundland	75,990	62,051
Quebec	875,874	944.160
West Indies	9,356	......
United States	106,279	98,027
Other countries	......	3,877

The production was 2,281,454 tons compared with 2,320,916 tons in the year 1897. There is an increase in the sales in Nova Scotia, New Brunswick, Prince Edward Island and Quebec, the sales to the last named point coming close to the million mark. There has been a decrease in the Newfoundland and United States sales. It is confidently expected that in a few weeks shipments of gas coal to Boston from Cape Breton collieries will be commenced on a basis of at least 700,000 tons per annum. If this be carried out and no unforeseen obstacle intervenes, the total sales of next year should be in the vicinity of 3,000,000 tons. The total sales for the year were 2,135,397 tons, compared with 2,013,421 tons in 1897.

THE PRACTICAL MAN.

The Friction of Metal on Metal, without Lubrication—
May be taken at 1-6 of the weight up to 40 lbs. per sq. inch.
May be taken at 1-5 of the weight up to 100 lbs. per sq. inch.
Brass on cast iron ¼ of the weight up to 800 lbs. per sq. inch.
W'r't on cast iron 1-3 of the weight up to 500 lbs. per sq. inch.
Well oiled with tallow at 1-10 of the weight.
Well oiled with olive oil at 1-3 of the weight; 800 lbs. per inch forces out the oil; friction of journals under ordinary circumstances 1-30 of weight; friction of journals well oiled sometimes only 1-60 of weight.

Rules for Calculating Speed.—The diameter of driven given to find its number of revolutions: Multiply the diameter of the driver by its number of revolutions and divide the product by the diameter of the driven. The quotient will be the number of revolutions of the driven.

The diameter and revolutions of the driver being given to find the diameter of the driven, that shall make any number of revolutions: Multiply the diameter of the driver by its number of revolutions and divide the product by the number of required revolutions of the driven. The quotient will be its diameter.

To ascertain the size of pulleys for given speeds: Multiply all the diameters of the drivers together and all the diameters of driven together; divide the drivers by the driven. Multiply the answer by the known revolutions of main shaft.

To Drill or Turn Aluminum.—Use kerosene oil (coal oil) for drilling or turning aluminum.

To Drill Hard Steel.—Use turpentine instead of oil, when drilling hard steel, saw plate, etc. It will drill readily when you could not touch it with oil.

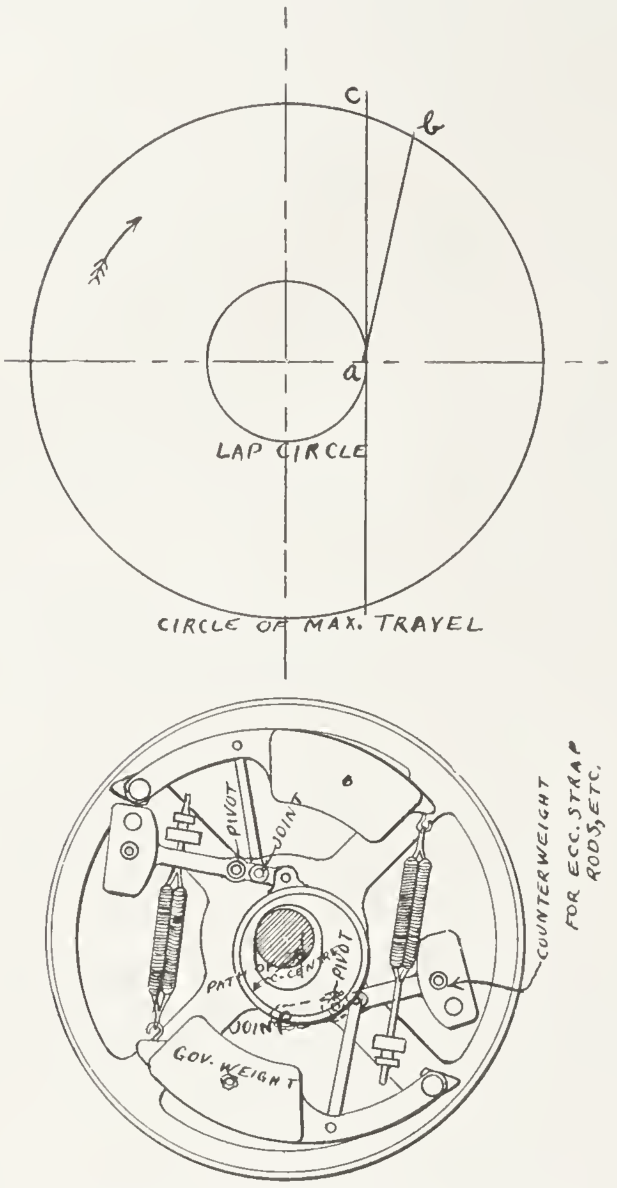
To Prevent Rust on Tools.—Use vaseline, to which a small amount of powdered gum camphor has been added; heat together over a slow fire.

Alloys.	Tin.	Copper.	Zinc.	Antimony.	Lead.	Bismuth.
Brass, engine bearing	13	112	¼	..	..	..
Tough brass, engine work	15	100	15	..	..	..
Tough, for heavy bearings	25	160	5	..	..	..
Yellow brass, for turning	..	2	1	..	..	..
Flanges to stand brazing	..	32	1	..	1	..
Bell metal	5	16	..	..	..	..
Babbitt's metal	10	1	..	1	..	..
Brass, locomotive bearings	7	64	1	..	..	..
Brass for straps and glands	16	130	1	..	..	..
Muntz's sheathing	..	6	4	..	..	..
Metal to expand in cooling	..	..	..	2	9	1
Pewter	100	..	..	17	..	..
Spelter	..	1	1	..	..	..
Statuary bronze	2	90	5	..	2	..
Type metal, from	..	..	..	1	3	..
Type metal, to	..	..	..	1	7	..
Solders.						
For lead	1	..	..	..	1½	..
For tin	1	..	..	..	2	..
For pewter	2	..	..	..	1	..
For brazing (hardest)	..	3	1	..	..	..
For brazing (hard)	..	1	1	..	..	..
For brazing (soft)	1	4	3	..	..	..
For brazing (soft), or	2	..	..	1	..	..

NOTES ON SHAFT GOVERNORS.[*]

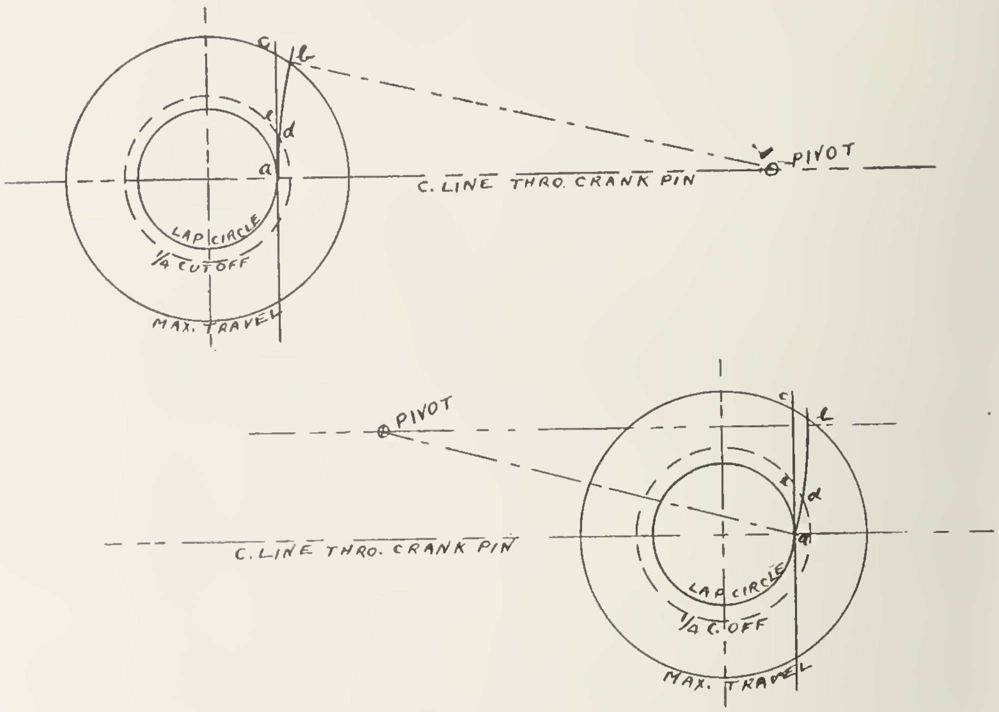
BY W. B. M'LEAN.

The following paper does not propose to discuss the many difficult mathematical and other problems involved in a treatment of the theory of shaft governors. It will only deal with some practical points in the design of these appliances which have come to the notice of the writer during a summer spent at work connected with high-speed engines which were thus governed. The shaft governor is the means now almost universally employed for regulating the speed of the modern (American) high-speed engine. In most American engines it acts by changing the point of cut-off of the valve, and thus varying the volume of steam admitted to the cylinder at each stroke to suit the varying loads. This of course changes the ratio of expansion; but between the ordinary limits of cut-off, under working conditions, the variations of this ratio do not greatly affect the economy, and the regulation is much quicker than with the old type of throttling governor.



Figs. 1 and 2.—Automatic Governor. Fitchburg Co. Steam Engine.

In the older forms of shaft governor the cut-off was changed by having an eccentric of the ordinary type placed loose upon the shaft, which was turned around by the governor so that the angle of advance varied, about from 0° to 90° under the full movement of the governor. (Fig. 9.) In more modern forms, however, the object is to have the eccentric centre describe a path, relatively to the shaft, such as that shown in Fig. 1. Here the large circle has a radius representing, on some scale, the half-travel of the valve or the throw of the eccentric, at the point of greatest cut-off, and the small circle has a radius representing, on the same scale, the outside lap; *b* is the position of the eccentric centre which gives the proper lead when the valve has its greatest travel. The path which the eccentric centre is required to describe under the action of the governor is from *b* to *a* where *a* is a point either at or slightly inside of the intersection of the lap circle with the centre line through the centre of crank pin and centre of shaft. At the minimum travel of the valve there will then be no admission of steam at all to the cylinder and the lead will diminish from *bc* to *o*, or to a small negative lead at *a*, as the eccentric is moved in by the governor. The form taken by the line *ba* is a matter on which designers differ. In the governor shown in Fig. 2 it is made very approximately a straight line by an application of Watt's parallel motion. The form usually adopted, however, is that of a circular arc, the eccentric plate being pivoted directly on the supporting governor frame or wheel. By this arrangement a greatly increased rigidity is obtained to resist the pull necessary for moving the valves; which pull generally comes at a considerable off-set. There are two ways in which this pivot may be placed as shown in Figs. 3 and 4. To compass the two the circle is drawn which represents the path of the eccentric centre at ¼ cut-off. The lead at ¼ cut-off is in each case *de*; and it will be seen that the arrangement of Fig. 4 gives much more lead and also a greater maximum port opening at the early cut-offs than does that of Fig. 3.



Figs. 3 and 4.

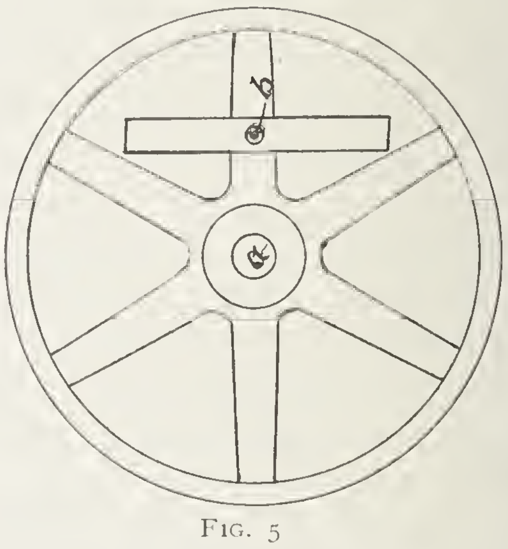


Fig. 5

The desired movement of the eccentric plate is ordinarily obtained by connecting it to weights, pivoted in the governor frame so as to be movable in the plane of rotation, the movement of the weights being controlled by springs. When the rate of rotation of the shaft changes new forces act on the weights which produce the desired movement. The most im-

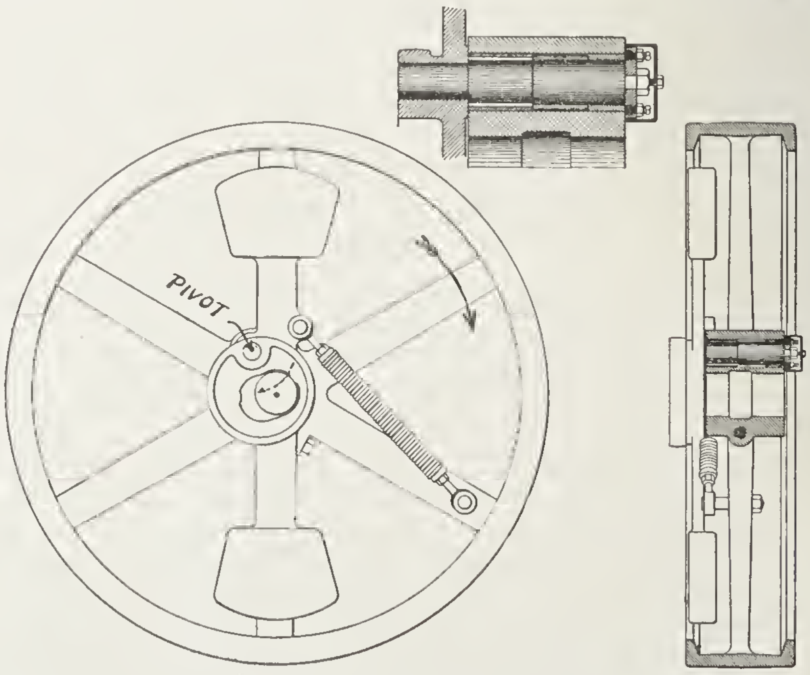


Fig. 6.—Rites Governor as used by Fischer Foundry and Machine Co., Pittsburg.

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[*] A paper read before the Applied Science Graduates' Society of McGill and published exclusively in the Canadian Engineer.

portant of these is the change of the centrifugal force. This is, however, by no means the only force made use of. Forces due to the inertia of the masses themselves are now largely used. Suppose we have a weight, as shown in Fig. 5, in the form of a long bar pivoted at b to a frame rotating about a. Then in addition to its rotation as a whole about a, the weight will have a rotation at the same rate about b. If the rate of rotation about a change, that about b will still tend to remain the same, and the weight will consequently turn on the pivot b. The couple producing this movement depends for its magnitude upon the moment of inertia of the weight about the axis through b. This couple may be called angular accelerating couple. The Rites' governor, which has been recently brought out and is now used by a large number of prominent American engine builders, depends for its action principally upon this force. As seen in Fig. 6 the weight arm and eccentric plate are made in one piece, thus necessitating the arrangement of the pivot shown in Fig. 3. This governor gives very quick regulation, but from the very nature of its action a light fly-wheel must always be used with it. Its action depends not on the total change of rotation but on the rate of change or angular acceleration.

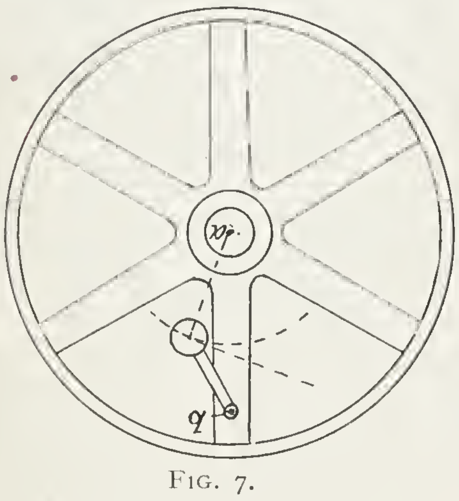


Fig. 7.

Let a weight in the form of a ball at the end of a lever arm be placed in some such position as that shown in Fig. 7, so that the tangent to its path at the centre of gravity falls some distance to one side of the pivot. Then, if the rotation about a be accelerated, it is evident that on account of its inertia the weight would resist the change of linear velocity due to a change of angular velocity (and of radius of rotation if a movement about b did occur), and a force would be produced tending to cause motion of the weight about b. But this is not the only force developed in this case, and Prof. J. G. Klein has demonstrated to the satisfaction of leading engineers, who have discussed this subject (see Trans. Am. Soc. M.E., 1897, discussion on paper by F. H. Ball, p. 311), that in such a case the resultant of all the forces developed always passes through the pivot. The force mentioned will therefore not be available for governing. The two prominent forces made use of in shaft governing will then be centrifugal force and angular accelerating couple, and it is in the combination or opposition of these that the action of different governors varies.

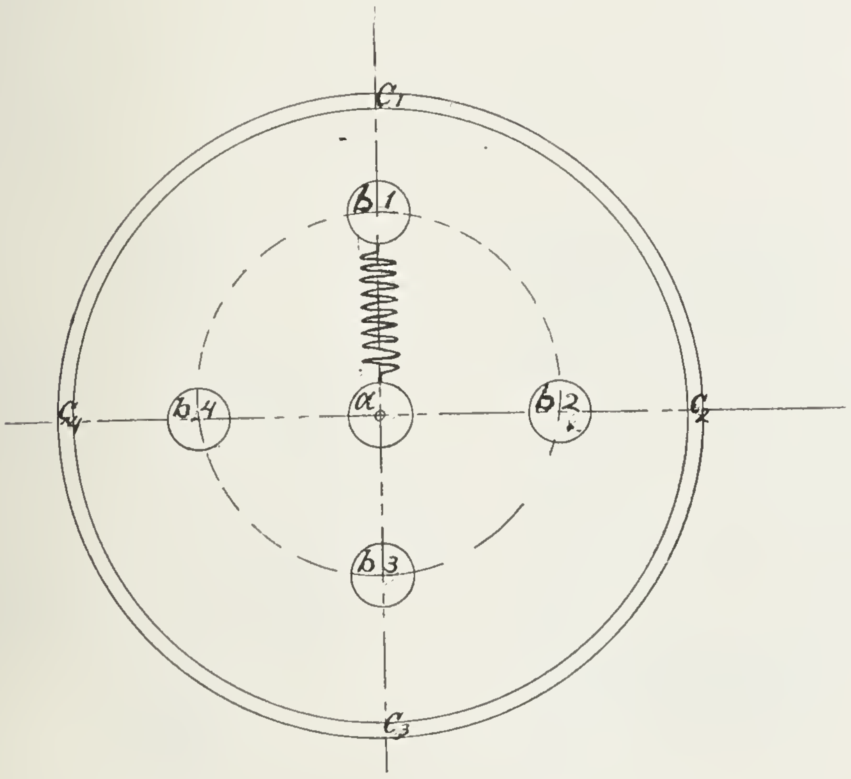


Fig. 8.

In the case of weights rotating about a horizontal axis as is the case in shaft governors the effect of gravity must be taken into account. To show what this would be in the case of a single unbalanced weight take the following case: Suppose a wheel (Fig. 8), moving at a constant rate of rotation to have a weight placed in it so as to be movable, without friction, only along the radius ac, of which ac_1, ac_2, etc., are successive positions as the wheel makes a revolution. Also suppose that a spring is attached to it and to the wheel which balances the centrifugal force in all positions, that is makes it isochronous. Then the only force which we need consider will be that of gravity. Starting from the position b, the weight will be pulled towards a until it reaches b_2. At b_2 it will cease to be pulled towards a, but will then have a certain velocity inwards. From b_2 to b_3 this velocity will be destroyed by the retarding force of gravity pulling it away from a again. At b_3 it will have reached its nearest position to the centre a, and will start moving out again. At b_4 it will have its greatest velocity outwards, which from b_4 to b_1 will be destroyed again by gravity until it reaches its extreme outward position at b_1. By experiment and mathematical demonstration Prof. S. P. Robinson has shown (Trans. Am. Soc. M.E., 1890, pp. 1055-64, discussion on paper by J. E. Sweet), that the path of the weight under these cir-

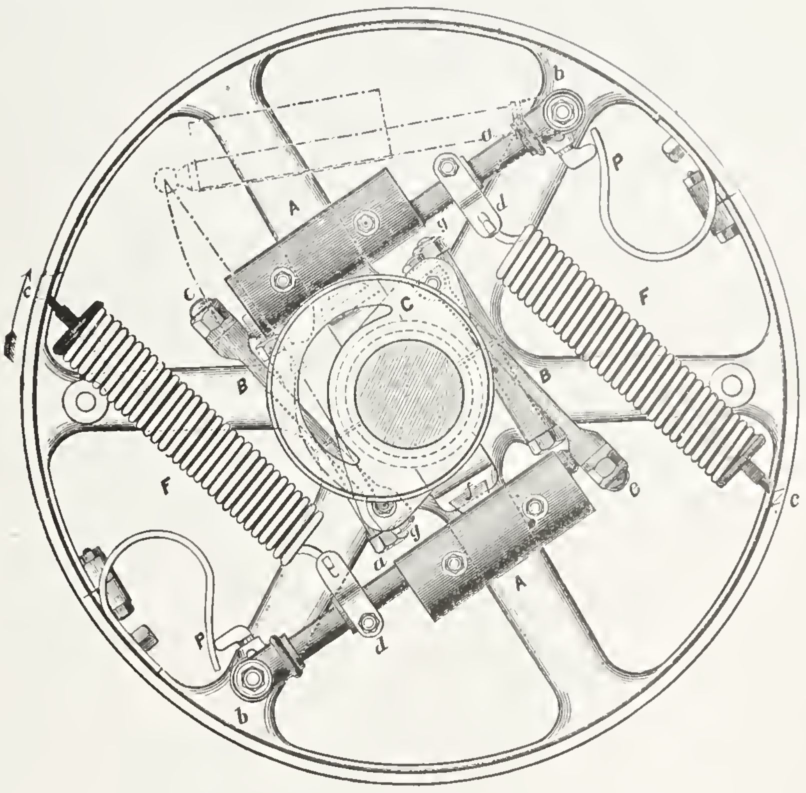


Fig. 9.—The Buckeye Engine Co.'s Isochronal Governor.

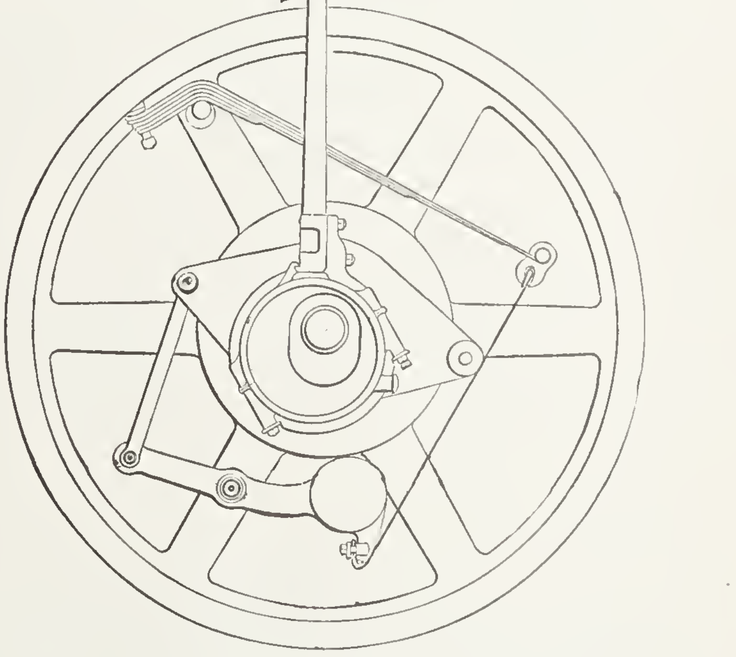


Fig. 10.—Governor and Valve Motion. Straight-Line Engine Co.

cumstances is very nearly a circle, whose centre is vertically above the centre of rotation by a distance $\frac{g}{w^2}$ where $g=$ acceleration due to gravity and $w=$ angular velocity in radius. It will be seen from the above that if a governor weight be unbalanced, one effect of gravity will be to make it move more or less on its pivot at every revolution, and thus move the whole governor. The argument for balancing is that this makes the pins wear out and necessitates increased lubrication. Two methods of balancing may be noticed. The first is that of duplicating the weights and connecting them to opposite sides of the eccentric plate pivot as in the governor shown in Fig. 9. The second, shown in Fig. 10, is to make the weight of the eccentric plate and connections balance that of the weight. The governor shown in Fig. 2 presents a peculiarity in balancing in the counterweights *o o*, which are put in to balance the weight of the eccentric plate and strap, and in vertical engines of the valve and rods also, and thus relieve the governor of these disturbing influences.

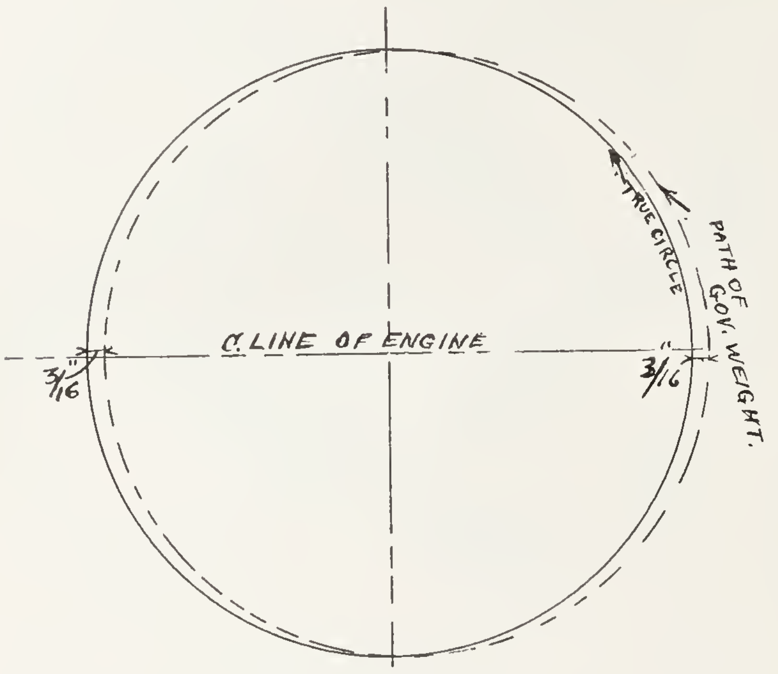
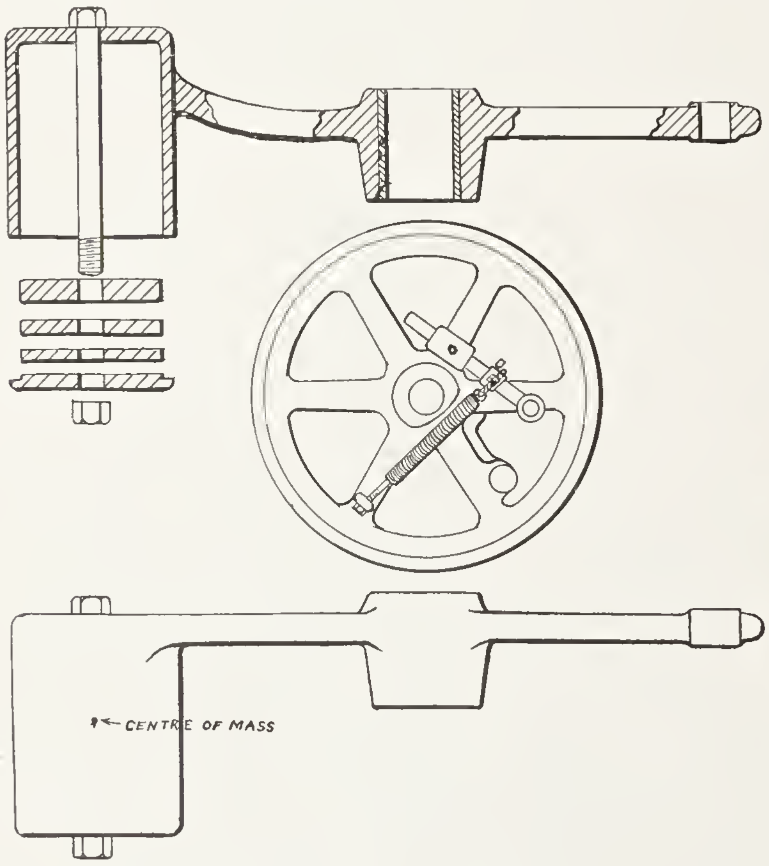


Fig. 11.



Figs. 12, 13, and 14.

The resistance of the valve is another element of disturbance in the shaft governor. It is principally due to three causes, friction, inertia, and unbalanced steam pressure. The friction in the best practice is reduced to a minimum by the use of balanced valves, and by accurate scraping processes, thorough lubrication, etc. The inertia is reduced by making the valve and connections as light as possible. The unbalanced steam pressure is not generally accounted for as it is not generally recognized as a disturbing force. It is due to the unbalanced area of the valve rod which enters one side of the steam chest and does not usually pierce the other. Thus the pressure on the one side of the valve will not be perfectly balanced by that on the other, and there will be a constant force tending to push the valve towards the shaft, which will be equal to the area of the valve rod steam pressure per square inch. In conjunction with the others mentioned this force may cause considerable trouble in a governor, as may be illustrated from the case of a 12-inch tandem compound engine, which was found to have too light a governor. A pencil was attached to the governor weight and a board was held up against it while the engine was running, and thus the actual path of the weight was traced on the board. The true circle concentric with the shaft, which the pencil would describe if the weight had been fixed in the wheel, was also described on the same diagram. It was thus found that the path of the governor weight was, as shown in Fig. 11, sensibly a circle whose centre was displaced horizontally from the centre of the shaft by about 3-16 of an inch. This of course disturbed the adjustment of the valves, both of which were attached to the governor in this case, and made it necessary to put on a much larger and more powerful governor. Some makers point out the influence of the valves as rather an advantage, and seemingly for the same reason that the somewhat similar effect of gravity is claimed by others to be a disadvantage. It is argued that the alternate push and pull due to the inertia and friction of the valve gear tends to, and doubtless does produce a small movement of the governor and that this overcomes the friction of rest at the joints four times in each revolution, thus making the governor more sensitive and free to act. Governor weights, especially when in the form of a ball and lever, are often made adjustable both as to mass and leverage. An adjustment for mass is shown in Fig. 12, where the governor ball is cast hollow, of malleable iron and weights of varying thickness put in until proper working is secured. Adjustments for leverage are made by making the weight so that it can be moved along the lever arm and clamped in any desired position as shown in Fig. 13. A consideration of some importance which is often lost sight of in designing governor weights is to so distribute the mass of the weight as to avoid as much as possible twisting couples on the weight pivot at right angles to plane of rotation, as these cause rapid and uneven wear. To illustrate what is meant Fig. 14 shows a possible

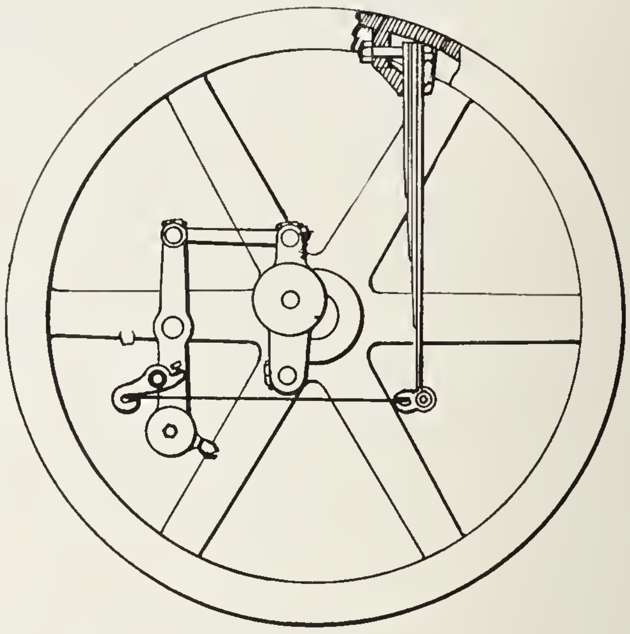


Fig. 16.—Robb-Armstrong Governor.

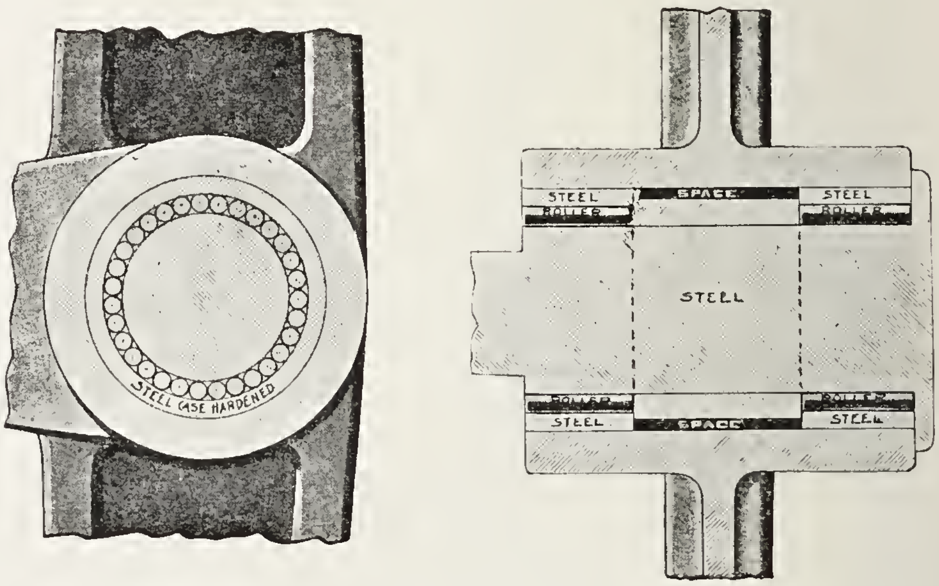


Fig. 17.—Roller Pin Bearing. Ridgway Dynamo & Engine Co.

distribution of the mass of the weight shown in Fig. 12, which would cause it to have the bending or twisting couple about its pivot, referred to.

The springs used to control the movement of the weights are of two kinds, coil springs and flat-leaved springs. Coil springs are almost always used in tension. In using them stresses are developed due to the centrifugal force of their own mass, which at high speeds become of some importance and cause the spring to assume a slightly curved form. Means must be provided for adjusting their tension. Examples of these may be noticed in Figs. 6 and 13. The ends of these springs are generally fastened with simple pins as shown in Fig. 6, but sometimes have knife-edge bearings to do away with friction. There are two ways in which flat-leaved springs may be used, either to push the weights in as shown in Fig. 15, the weight being on the same side of the centre as the spring, or to pull it in by a connecting strap, the weight and spring being on opposite sides of the centre as shown in Figs. 10 and 16. In the arrangement of Fig. 15 the centrifugal force due to the mass of the spring itself will oppose its action, and if the spring be made stronger to resist this opposing force its mass must be increased, and thus the opposing force will also increase and hence a much stronger spring is necessary with this arrangement than with that of Figs. 10 and 16, where the centrifugal force of the spring itself assists its action. Arrangements for adjusting the tension of flat-leaved springs are applied, either at the fixed end of the spring, as shown in Figs. 10 and 16, or at the moving end, as shown in Fig. 15. When the spring is connected to the weight by a metal strap an important and useful adjustment of the spring's action may be made by the use of a quadrant, as shown in Fig. 16. As the weight goes out the leverage of the spring in acting on the weight may be made to vary in any desirable way by adjusting the quadrant to different angles about its pivot, and by making the face in profile of different curves. The curve usually adopted, however, is that of the arc of a circle.

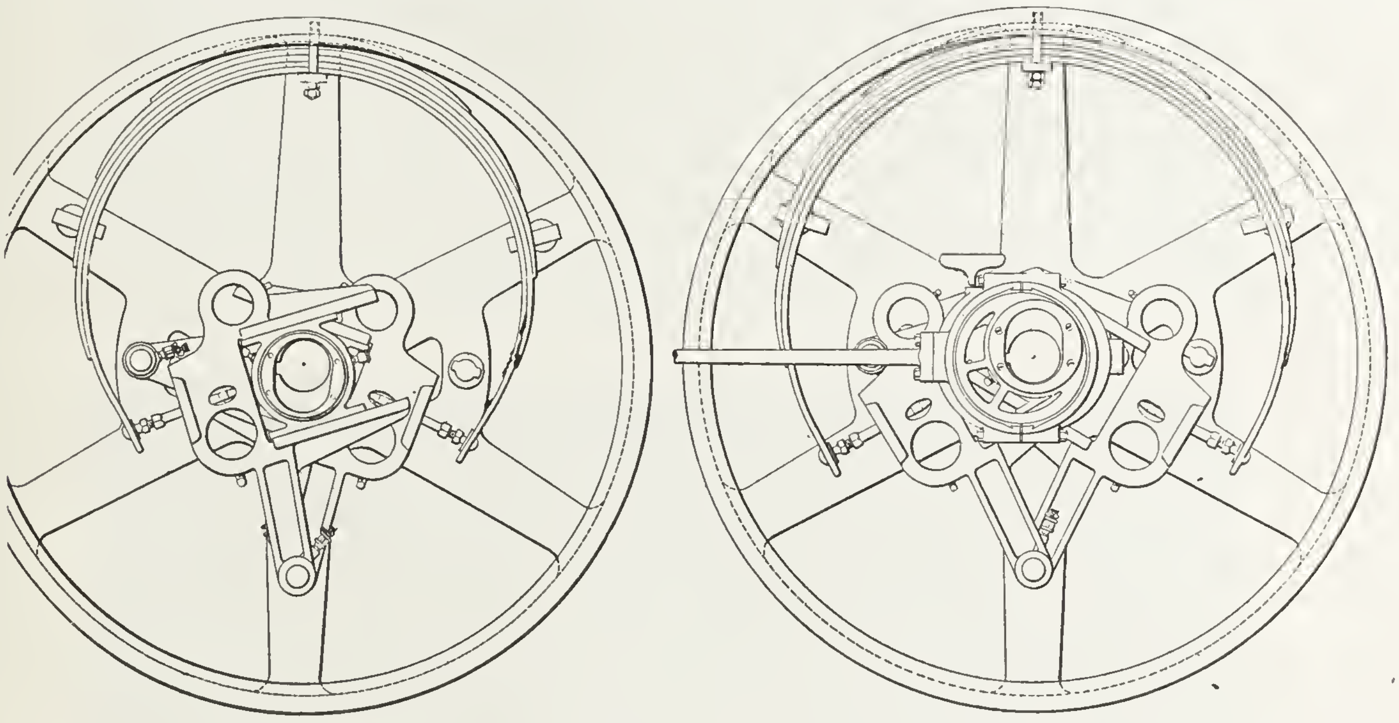


Fig. 15.—Governor for Single Valve. McIntosh, Seymour & Co.

The joints and pivots are among the most important items to be considered in the construction of a governor. If there be too much friction the governor is apt to stick at first when the load changes, and then to move suddenly and too far, thus causing racing of the engine. The ordinary construction is to bore out the bearing, say ⅜-inch larger than the pin, and to press or clamp in a bush, which can be replaced when it wears out. These bushes are usually of hard babbitt metal or some similar alloy, or of brass, but graphite is often used. A more expensive construction, which is coming into favor, is that of a roller pin bearing, as shown in Fig. 17. Governors have been designed with the weights pivoted on knife-edges, but the idea does not appear to have been prosecuted with much success, although knife-edges are used on the springs by some makers as has been mentioned. The shaft governor has now been brought to such perfection that the variation of speed with the best types between no load and full load or between maximum and minimum boiler pressure, is a small fraction of 1 per cent. of the average speed. They are so simple in their action that they require almost no attention, and with proper design and workmanship are as durable as any part of the engine.

THE ELECTRIC POWER AND LIGHTING PLANT OF THE SOULANGES CANAL.

The Canadian General Electric Co. is supplying the electric power and lighting plant for the Soulanges Canal upon specifications of which the following is an outline:

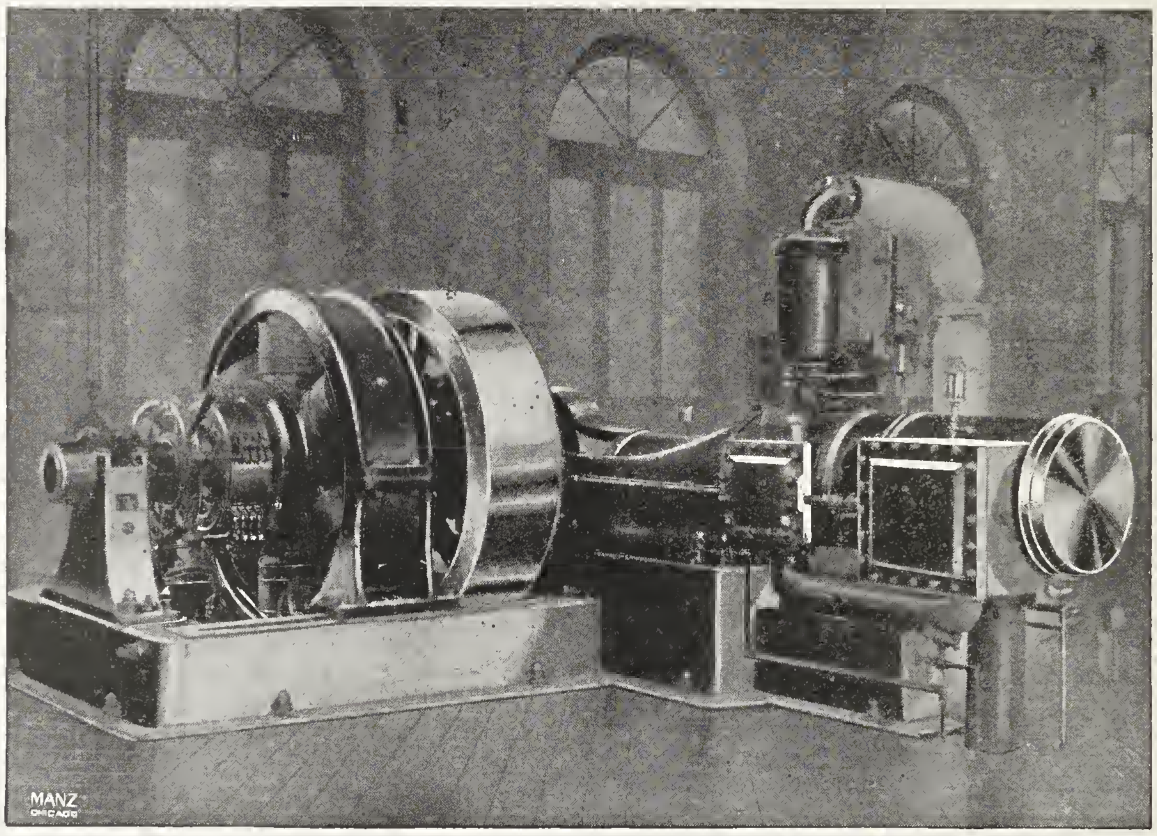
Generators.—There will be two generators of multi-phase type of 110 amperes at 2,400 volts, (264 k.w.) when operated at a speed of 225 r.p.m., frequency 60 p.p.s. Each generator to be direct connected, and when the generators have been operated at the above capacity for twelve consecutive hours, the temperature of the hottest part of the machine shall not be more than 45 C. above that of the surrounding atmosphere. The machines are to be so constructed that the insulation between the armature winding and frame of the machines and also between phases, will withstand a break-down test of 6,500 volts for five consecutive minutes, such test being made with a transformer of not less than 4,000 watts capacity. The insulation between field winding and frame of machines shall withstand a break-down test for five consecutive minutes of an alternating voltage equal to five times the voltage to be used in exciting the generators. The armature and field winding insulation to be capable of withstanding the break-down tests specified, immediately after generators shall have been operated at the load runs above stipulated. The generators will have an inherent regulation of at least ten per cent. The generators are not to have so-called "compounding devices." Regulating appliances must be provided so that the E.M.F. of each or any phase may be varied ten per cent entirely independently and separately from each other. When the generators are operated under full load they shall have a commercial efficiency of at least ninety-two per cent.; when operated at half load, of eighty-nine per cent., and at quarter load of eighty-four per cent.

Exciters.—There are to be two exciters of modern design, with self-oiling bearings, and to be provided with a belt-tightening device. The armature to be of the iron-clad type, and the armature coils "machine wound." The capacity of the exciter to be such that it will deliver continually, without undue sparking, exciting current to an extent equal to two times that required by one generator when it is operating at its maximum load. The temperature of any part of either exciter, after working for twelve hours at about stated output capacity, shall not exceed 45° C. above the surrounding air.

Switchboard Appliances.—The switchboard appliances will be mounted on marble slabs, supported on an oak or iron frame, and consist of the following instruments: 2 voltmeters, 2 main switches or set of switches, 2 voltmeter transformers, 2 exciter switches, 2 voltmeter switches, so arranged that the voltage can be determined of each phase, 1 ampere meter for each phase of each generator, 2 generator rheostats, 2 exciter rheostats, 2 motor circuit switches and ampere meters, 2 arc light circuit switches and ampere meters, 1 static ground detector, 1 switch for ground detector, so that connections can also be made to each phase, also the necessary bus bars, pilot lamps, etc. There shall also be supplied the necessary lightning arresters for the protection of the switchboard and generating apparatus from lighting discharges from the outside line; each lightning arrester to be equally efficient as any at present made.

All wiring in connecting the generator and exciter to switchboard and to line to be done with rubber-covered wire and according to the rules and regulations of the Canadian Fire Underwriters' Association.

Motors.—The following motors to be furnished, erected and installed in motor housings, to be furnished by the contractor at each one of the five locks: Lock No. 1, at the lower entrance to the canal; lock No. 2, at about 1,900 feet from the lower entrance of the canal lock; No. 3, at about ¾ of a mile from the lower entrance of the canal; lock No. 4, at about 3 miles from the lower entrance of the canal; lock No. 5, at the upper entrance of the canal or about 14 miles from the lower entrance of the canal; guard gates at about 3½ miles from the lower entrance of canal. Twenty (20) 1 h.p. motors, one to be connected to each of the four sluice gates at each lock, each motor to be provided with the necessary mechanism, reducing gears, etc., to operate the shafts of the sluice gates; twenty-two (22) 7 h.p. motors, one to be connected to each of the gates at each lock, each motor to be provided with the necessary mechanism, reducing gears, etc., to drive the pinions operating gate bars; each of the above motors to be also supplied with the necessary releasing or brake arrangement, so that in opening or closing the gates, the power may be released automatically so as to prevent any undue strain on the machinery in connection with the gates. Seven (7) 2 h.p. motors, each to be placed and connected with suitable mechanism ready for the operation of each of the seven bridges, situated along the canal; each motor to be provided with its necessary switch, starting box, etc. One (1) 15 h.p. motor, complete, with the necessary starting box, switch sliding bars, etc., to be installed at a workshop to be erected near the lower end of the canal. At each of the five locks and at the guard gates there shall be installed in a building to be provided therefor, a switchboard to which will be provided the necessary switches and instruments for effectually and completely handling and controlling the operation of all the motors required at each lock. Where it becomes necessary for wires to cross the canal, such wires shall be lead covered, and shall be placed on the bed of canal or locks at places to be determined by the Government engineer, and shall be placed in such a manner that they cannot receive any injury.



Robb-Armstrong Engine at Madrid.

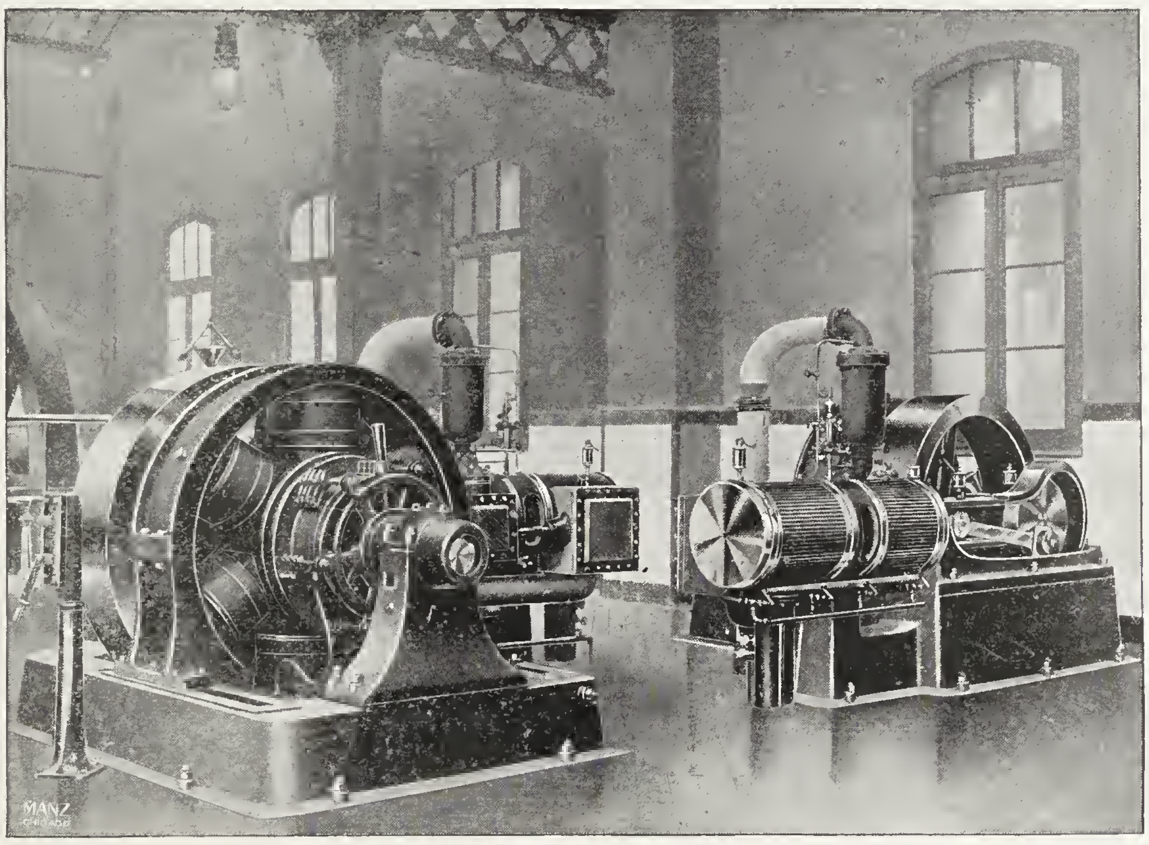
Transformers.—The following transformers are to be supplied and erected, as follows: 5 transformers, each suitable for four 1 h.p. and four 7 h.p induction motors, one to be installed at each lock; 2 transformers, suitable for two 7 h.p. induction motors, to be installed at guard gates; 7 transformers, each suitable for one 2 h.p. induction motor, one to be installed at each bridge; 1 transformer, suitable for one 15 h.p. induction motor, and to be installed at the workshop at the lower end of the canal. Each transformer will withstand a break-down test of 6,000 volts of alternating current, for five consecutive minutes, between the primary and secondary coils, between primary and iron, and between secondary and iron. No part of the transformers are to have a rise in temperature when in use at full load during twelve hours consecutively, of more than 45 C. above the surrounding air.

Arc Lamps.—There shall be 194 alternating current, 60 cycle, 12 hour open arc lamps. Each arc lamp will be of nominal 2,000 c.p., and consume not more than 500 watts per lamp. There will also be 320 incandescent lamps of 16 c.p. each.

CANADIAN ENGINES IN SPAIN.

In October, 1897, contracts were given for the equipment of electric tramways in Barcelona and Madrid, the two most important cities in Spain. The work was completed a few months ago and the lines are now in successful operation. Barcelona with a population of about 600,000 is the largest city in Spain, and is an important seaport and manufacturing centre. It is an ideal city in many respects but particularly from the standpoint of the owners of the electric railway, as it is well patronized on account of the climate being too warm for walking. Madrid is the capital of Spain, and is nearly as large as Barcelona. It is situated inland, and has many parks, broad streets and fine buildings. In the character of its population it resembles a western American city, as not more than 40 per cent. of its residents are natives. Although these systems are owned by British capital and built by British contractors, much of the apparatus was purchased on this side of the Atlantic. The main engines were manufactured in the United States, and three smaller engines were supplied by the Robb Engineering Co., Amherst, N.S. These engines, as shown in the accompanying illustrations, are tandem compound, of the side crank type with dynamos direct connected. They were put in principally for lighting the extensive car sheds and driving the machinery in the workshops connected with the tramway systems, but are also used for running part of the cars late at night or early in the morning when the main engines are shut down. The high pressure cylinder of these engines is 10 inches in diameter, low pressure 16 inches in diameter, stroke 15 inches, and they are rated at 115 h.p. each. Both valves are controlled by the automatic governor in such a way as to divide the work equally between the two cylinders. The crank shaft, connecting rod and crank pin are of hammered open-hearth steel. The high pressure cylinder is placed next the frame, the low pressure in the rear so that the cylinder heads and pistons can be removed without disturbing the cylinders. The throttle consists of a flat valve rotated through one-half revolution by a lever, and as the valve and seat are protected from the steam whether open or shut they can neither wear nor rust. The main bearings have a ring oiling device, the oil being continuously conveyed from a cavity beneath the bearing to the top of the shaft by metal rings which dip in the oil. All bearings are large and the parts of the engines few and simple, and as strong as possible, making them well adapted to any service where continuous running and variable or severe work is required.

It is highly creditable to the Robb Engineering Co. that its engines were selected as part of these installations, which are said to be the most important undertakings of the kind completed in any part of the world during the year 1898. The products of this firm have been favorably known throughout Canada for a number of years, and we have no doubt the foreign shipments, which have been quite numerous during the past year, will give as great satisfaction and lead to a large increase of business.



Robb-Armstrong Engines at Barcelona.

MINING METHODS.

Editor Canadian Engineer :

Would you kindly give me some information through your valued monthly in regard to placer mining, panning, sluicing, etc. J. H.

North Bay, Ont.

[Placer mining is only practicable where free gold is deposited in beds of sand and gravel. The sand underlying the gravel of streams is the most likely place, and the gold will be found—owing to its great weight—where eddies or bends in the stream check the speed of the current, thus allowing the gold to settle. The most simple way of extracting gold from the sand is by panning. A shovel full of sand is placed in the pan, which is a steel dish, shaped very much like a frying pan, about 15 inches wide and 3 inches deep, with sloping sides. The loose, light mud is then washed out with water, and the large pebbles removed by hand. The sand is then subjected to washing, which is done by giving the pan a circular motion, and adding water at the same time; in this way all the light sand is washed over the edge, leaving behind a heavy residue, mostly black iron ore, and the gold. If the gold is in fairly large nuggets it can be extracted by further panning, as it is so much heavier than the black sand, but if it is in a fine state it will have to be treated with mercury, this is done by mixing the sand thoroughly with mercury, and squeezing in a buckskin bag, thus freeing the mercury from the alloy. The gold can then be extracted from the alloy by heat. Skill in panning can only be obtained by considerable practice. In the case of a large deposit of auriferous gravel the best way to treat it—if circumstances allow—is by hydraulicing; this is done by playing a stream of water, under considerable head, upon the gravel deposit, which will be carried by the water through a number of sluices, which are large, frame troughs lying on the ground and paved with wooden blocks or riffles, which are fit to catch the gold and amalgam. The sluices are slanted according to the nature of the gravel worked and the supply of water, and are made long enough so that a test of the balings being taken, no gold will be found. The supply of water must be sufficient to cover the largest boulder met with, and is supposed to carry away 1-5 its own weight in gravel. Mercury is added several times daily at the sluice head. The stream of water, sometimes under a head of 400 feet, is directed by a nozzle (monitor), of from 5 to 9 inches in diameter. When it is time for a "clean up" the water is turned off, all the loose gravel picked out and the gold and amalgam carefully collected. Under favorable circumstances gravel running as low as 2 to 3 cents per cubic yard can be treated with profit by this method. The gold rocker is such a crude home-made affair that it is difficult to get cuts of it, but it may be found in some text-books on gold mining, for instance in "Gold (Metallurgy of)" by T. H. Rose. Roughly, it is a wooden box, 3 feet long by 1½ feet wide, one side being knocked out, and resting on two rockers, one of which is lower than the other, thus giving the floor a slant from back to front. About two feet above the floor is a removable riddle box, 3 feet long by 9 inches wide, with ½ inch mesh screen; below the riddle and forming an angle of about 30 deg. with it, and slanting toward the back of the rocker, is stretched a piece of blanket or canvas apron, the length of the rocker and about 10 inches wide. The gravel is placed in the middle box with water, which washes it through into the apron; here the fine gold is caught, and the dirt passes out from back to front over the bottom where the heavy sand and coarse gold is caught by two or three riffles nailed across the bottom. Mercury is sometimes added. The object of the rocking motion is to prevent the sand from packing behind the riffles. The capacity of a rocker of this description—two men washing—is from 3 to 5 cubic yards per day; the amount of water used is 3 or 4 parts to 1 of gravel.—Ed. Can. Eng.]

DAM BUILDING.

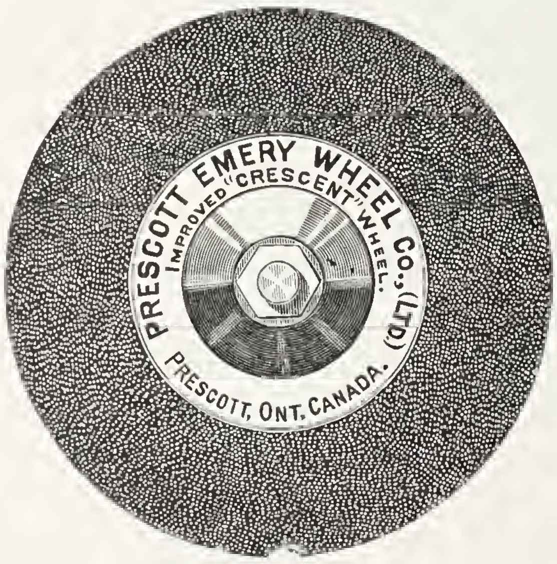
Editor Canadian Engineer :

Your January number contains an article upon dam construction by Chas. Baillairge, which opens up discussion upon a subject which is of great importance at a time like the present, when so much capital is being invested in the development of water power plants in all parts of the country. Mr. Baillairge, quite rightly, in my opinion, advocates the use of concrete for such works. In approaching the question of ratio of thickness to depth of water, however, it will be necessary to take into account some other factors in the problem which Mr. Baillairge has not embraced in his statement of the matter. The length of the structure should be considered as well as the depth of the water. About 1-10 of the length will figure out a good proportion for dams of moderate length, provided this is not less than .5 of the depth of water. This width being increased by footing courses so as to give a total width of effective base to resist overturning equal to .8 of the depth of water. The proportion of .5 however, should be maintained to the top of the dam, and the dam should not be tapered off at the top as is the customary practice. By building the dam of a uniform thickness, the structure is much better equipped for resisting the action of moving loads, and it is my belief that engineers will fail in the search for a satisfactory formula for the strength or proportioning of dams, until they recognize the presence of moving loads upon such structures. It has long been known that the stresses caused by the moving loads were the most destructive in the cases of bridges and buildings, and it will have to come to the same point in regard to dams. The arched design spoken of by Mr. Baillairge is of doubtful advantage. If it is properly equipped at the abutment ends for receiving thrust, it may possibly contrive to act as an arch, but if the same amount of material were put into a straight dam, and the transverse section so designed as to enable the structure to resist moving loads, it would be a much better dam than the more slender extended structure in the form of an arch would ever be.

Yours truly,
Jno. S. Fielding.
3606 Boquet St., Pittsburg, Pa., Mar. 14th, 1899.

A STUDY OF EMERY WHEELS.

Emery wheels that were thirty years ago practically unknown and forty years ago not manufactured, are to-day an article understood by everyone who knows the uses of a grindstone. Emery is a mineral; the best quality, and that which is used almost exclusively being found in Turkey. The Canadian trade is supplied by United States and English mills which crush and grade it, at the same time clearing it of impurities. The manufacturing of wheels is done by a variety of processes, many of which are adapted only for special varieties of grinding. The wheel that is most called for and which must be of good quality to prove a labor-saving and durable article is a general purpose wheel. What we mean by a general purpose wheel is one for coarse work, such as castings, steel, and all kinds of metal. The two varieties of wheels which have heretofore principally been used for this purpose are what is known as the "Vitrified" and "Silicate." The "Vitrified" wheel is taken from the same process as a brick-maker would make brick, with various alterations to make it much harder and hold the emery up to its work to give it cutting properties. This has proved itself to be a very good process, but being of a glassy nature it is very liable to break, and thus has to be used with caution. The high speed at which it has to run to prove a good cutting wheel also proves a detriment to its use. The "Silicate" may be said to be the first and last, being in use for a great number of years it is yet more used as a general purpose wheel than that of any other process. The chief ingredient in the bond of this wheel is silicate of soda, sometimes known as "liquid glass," commonly called silicate. This can be used with safety, as a defective wheel can easily be detected, it is claimed, by tapping it gently with a hammer, if cracked or defective in any way it will give a dull sound, whereas a good wheel will ring sharp and clear.


PRESCOTT EMERY WHEEL CO. (LTD)
IMPROVED "CRESCENT" WHEEL.
PRESCOTT, ONT. CANADA.

Some two years ago a combination of the "Vitrified" and "Silicate" wheel was attempted by the Prescott Emery Wheel Co., limited, and they have now on the market a wheel known as the "semi-vitrified" wheel, which contains the good qualities of the two already referred to, together with its own advantages. It is said to be waterproof, can be used wet or dry, the bond being of such a nature that it has cutting qualities as well as the emery contained therein. It is perfectly safe, as it can be tested, which, it is claimed, cannot be said of the "Vitrified" wheel, and has advantages over the "Silicate" wheel inasmuch as the bond therein contains no cutting qualities which clog the faces of the particles of emery, causing it to glaze and burn the work instead of cutting it. The semi-vitrified always has a cutting surface, which cuts very fast and cool. The manufacturers claim that this process is rapidly taking the place of the other two processes mentioned, as the results wherever they are used show forth.

To procure the greatest amount of work from an emery wheel and ensure safety in running, only the best grinders should be used. The arbor should be of sufficient proportion to easily carry the wheel adjusted on it. The following table will give an idea of the correct size of arbor: Wheels 6 in. in diameter and less, ½ in. arbor, 7 to 10 in. inclusive, ¾ to 1 in.; 12 to 14 in., 1¼ in.; 16 to 18 in., 1½ in.; 20 to 24 in., 1¾ to 2 in. In mounting a wheel, it should slip on the arbor easily, never force it on the arbor. Keep boxes of machine tight, so as arbor will not jump. Keep rests close up to wheel. The collars should be one-third the size of the wheel, and made slightly concave to touch the wheel only at their circumference; washers of paper or some other pliable nature should be used between the wheel and collar. All our wheels are supplied with circular labels which serve to protect the wheel in this capacity. The cutting surface of the wheel, to give good satisfaction, should be kept true. This can be done with a dresser or diamond tool. All emery wheels should be run at a surface speed of 5,500 feet per minute. By running at speed marked on the label of every wheel, this can be attained. Running faster than this speed will cause it to glaze, burn the work and a certain risk is involved. By running too slow, it wears the wheel unnecessarily and does no more work. The Aikenhead Hardware Co., Toronto, carry a full line of wheels of the Prescott Emery Wheel Co.'s manufacture.

TABLE OF EMERY WHEEL SPEEDS.

Diam. Wheel.	Rev. per Min. for Surface Speed of 4,000 ft.	Rev. per Min. for Surface Speed of 5,000 ft.	Rev. per Min. for Surface Speed of 6,000 ft.
1 in.	15,279	19,099	22,918
2 in.	7,639	9.549	11,450
3 in.	5,093	6,366	7.639
4 in.	3,820	4.775	5.730
5 in.	3.056	3,820	4,584
6 in.	2,546	3,183	3,820
7 in.	2,183	2,728	3.274
8 in.	1,910	2,387	2,865
10 in.	1,528	1,910	2,292
12 in.	1,273	1,592	1,910
14 in.	1,091	1,364	1.637
16 in.	955	1,194	1.432
18 in.	849	1,061	1,273
20 in.	764	955	1,146
22 in.	694	868	1,042
24 in.	637	796	955
30 in.	509	637	764
36 in.	424	531	637

OUR FRIENDS SAY SO.

[Copy].

Depot Harbor, February 3rd, 1899.

Biggar, Samuel & Co., Fraser Building, Montreal, Que.

Dear Sirs.—Enclosed find $1, my subscription to Canadian Engineer for the year 1899. I like your paper, it contains a lot of information which is valuable to know and I would miss it if it were stopped. Wishing you a greater amount of success this year than ever before, I remain, yours truly,

D. S. Lough.

P.S.—Please address my paper to 354 Elgin street, Ottawa, Ont.

D. S. L.

[Copy].

The Riordan Paper Mills, Ltd.
Merritton, February 4th, 1899.

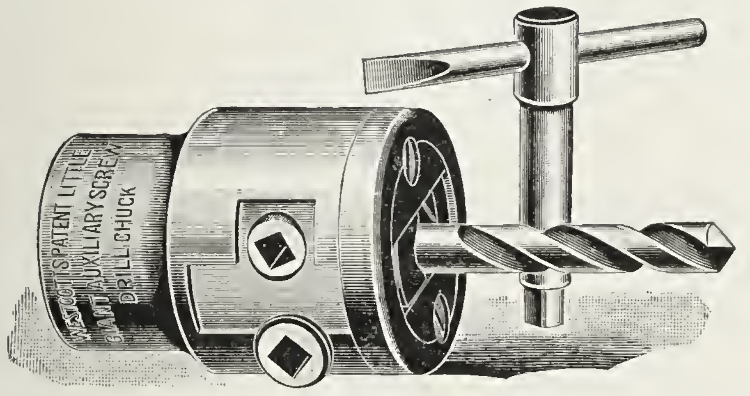
Biggar, Samuel & Co., Fraser Building, Montreal, Que.

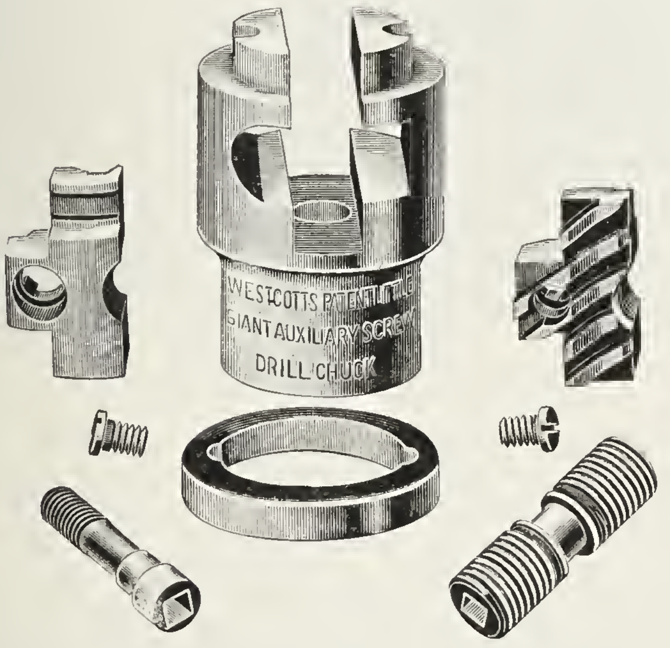
Dear Sirs.—I take pleasure in remitting you by P.O. order my subscription for The Canadian Engineer for the ensuing year to December, 1899. I consider this dollar better spent than most. Your paper surpasses any trade papers I have seen, in value of contents and its attractive style. I am glad it is "Canadian." Yours sincerely,

CHAS. C. RIORDON, JR.

LITTLE GIANT AUXILIARY SCREW DRILL CHUCK.

In addition to the popular Little Giant Improved, Little Giant Double Grip, and Oneida Drill Chucks, and Lathe Chucks of all kinds, the Westcott Chuck Co. is now furnishing the Little Giant Auxiliary Screw Drill Chuck, as shown in illustration. In drill chucks with side screws it is claimed that the inner or gripping part of jaws has a tendency to crowd away from the right and left hand screw, and the outer end of jaws has a tendency to draw toward the right and left hand screw. The auxiliary screw (in this new Little Giant Auxiliary Screw Drill Chuck) entirely overcomes said tendencies. After closing jaws on drill in the usual manner (by turning right and left hand screw), then tighten the auxiliary screw. This will greatly increase the gripping power of chuck. The effect of the auxiliary screw is similar to that of a bolt, as it virtually bolts the two jaws together. The ½-inch, ¾-inch and 1-inch sizes are made of pattern shown in the figures. The hole in the hub is made to fit the Morse taper, but can be bored out and threaded to suit the customer's templet at small cost. These chucks are also made with straight bodies, which are especially adapted for Hollow Spindle Lathes, for holding rods, round or square, which are to be turned or cut off. When a chuck is wanted for holding square work it should be so stated in order. The Aikenhead Hardware Co., Adelaide street, Toronto, reports a steady and increasing demand for the Westcott chucks.


WESTCOTT'S PATENT LITTLE GIANT AUXILIARY SCREW DRILL CHUCK


WESTCOTT'S PATENT LITTLE GIANT AUXILIARY SCREW DRILL CHUCK

NEW CATALOGUES.

The following catalogues have been received and are filed in our office, where they may be consulted at any time:

The Unbreakable Pulley and Mill Gearing Co., Ltd., West Gorton, Manchester.—A Treatise on the Economical Transmission of Power. Eighth edition. Cloth covers, 160 pages.

Darling Bros., Reliance Works, Montreal, Que.—Illustrated catalogue of Darling Bros., Reliance engineers, machinists and manufacturers of special and patented machinery. Boards, 100 pages.

Prescott Emery Wheel Co., Ltd., Prescott, Ont.—Catalogue and Price List No. 16.—Paper, 40 pages, illustrated. Attention is called to some new features, as the "Semi-Vitrified," which is more open in texture than the other wheels, and which has an abrasive bond.

Gas and Gasoline Marine Engines and Launches.—The John Gillies Estate Co., Carleton Place, Ont.

The Gartshore-Thompson Pipe and Foundry Co., Ltd., Hamilton, Ont.—Catalogue of cast-iron pipe (3 inches to 60 inches in diameter), for water, gas, culverts and sewers; also special castings, hydrants, valves, etc.

The Michigan College of Mines, Houghton, Mich., U.S.A. —The catalogue of the Michigan College of Mines, with statements concerning the institution and its courses of instruction for 1898-1900.

The Lehigh University, South Bethlehem, Pa., U.S.A.—The Register of Lehigh University, South Bethlehem, Pa., U.S.A.

The Massachusetts Institute of Technology, Boston. Annual Catalogue, 1898-1899; paper, 350 pages.

The Fairbanks Co., Montreal.—Illustrated Supply Catalogue; cloth, 250 pages; profusely illustrated, showing a full line of the varied mill supplies carried by this well-known company.

ROLLING OR RAMMING IN ROAD BUILDING.

Editor CANADIAN ENGINEER :

Sir,—There is one thing as to which the profession is entirely in the dark, and where information is capable of being afforded by such an institution as McGill University, under Professor Bovey's able direction, and supplied as the institution is, avowedly, with all the necessary and the best and most suitable machinery for the purpose. I allude to comparative statistics of ramming and rolling for purposes of street paving. What amount of pressure is equivalent to a blow from a hammer or pounder of a given weight, lifted by the operator to and descending from a certain height. In a word what weight of a road roller exerted on a given surface is equivalent to ramming the same in an efficient manner. Maybe an inkling of it might be obtained by estimating the force of impact used in driving a nail into a piece of soft or ordinary wood, and the pressure in pounds to be exerted to drive another nail in the same time to the same depth.

This question of ramming vs. rolling a road-bed or of rolling vs. ramming is most pertinent; and though of extreme intricacy, considering the rather indefinite breadth and area of the strip of surface on which the roller bears; still I am confident Mr. Bovey can make something of it and give us at least, and as soon as possible, to begin with, in view of the approaching season for paving, some approximate mode of being satisfied, which I am prone to believe that almost no imaginable weight of road rollers (10 tons, 20 tons or more) can be nearly as effective as ramming.

Another question to which I would invite your attention is a statement of the depth to which an impacting of the surface, or a rolling of it, will reach, in an effective manner. Of course, we know that in trench filling, the ramming amounts to nothing if left to be performed only when the trench is filled, and the filling should be rammed, in successive layers of six to eight inches it is supposed, and this is the practice followed out in embanking for reservoir dams; but still it is guess work more or less, and has not been calculated and reduced to a science as it should be, if possible. In trench filling, here in Quebec, by our gas company, when it excavates for any purpose, a man goes and comes along the bottom of the trench as it is being filled in from above, and in such a way as, by allowing say one rammer to half a dozen fillers, to ram almost every successive shovelful of filling as it goes down. This, of course, is the right thing to do, or should be, but could hardly be expected, over extended areas.

A heavy (steam) road roller is most deceptive. It inspires the general public with full confidence in its efficiency; but we are not, in such matters, to be guided by mere sentiment. Very little is known of the comparative effect of rolling and ramming. I have just now before me paving specifications, best or most recent editions of them all, from Washington, New York, Boston, Baltimore, Philadelphia and Chicago, and they are all at one in specifying "ramming or rolling with a 5 to 10 ton roller," as if the one were equivalent to the other. Now on the contrary, I do not know that even a 50-ton roller, which it would be impractical to use, would be an equivalent. I am far from stating this; having no data to go by, but suppose a rammer be 6-inches square, or of an area of 36 inches, and suppose a roller is 5 feet long or broad, and 5 feet in diameter, and weighs 10 tons, then will there be but one ton weight or pressure on every 6 inches lineal of the length or breadth of roller. Suppose, now that the effective breadth of the strip of surface pressed on by the roller be 6 inches, and it hardly could be less, on an already rolled surface, or after a first or second rolling without a versed line of sinkage into the surface to an extent to widen the cord of section of area sunk into by the roller. I say that in such a case, only one-tenth of weight of roller would come upon this surface or area of 6-in. by 6-in. or 36 square inches, and a comparison is now to be instituted, in how far this weight of one ton on one-quarter of a square foot is equivalent to a blow or succession of blows of a rammer of given weight falling from it or brought down like a hammer with a man's muscular effort in addition to the effect of its own or unaided weight or impact.

C. Baillairge,
Quebec, March 23rd, 1899. Consulting Engineer.

HARRIS VS. THE TORONTO ELECTRIC LIGHT CO.

The verdict against the defendant in Harris vs. the Toronto Electric Light Co. marks the first step in a legal fight which will be watched with absorbing interest by everyone interested in electricity, either as producer or consumer. The number of double services such as is alleged to have caused the fire is very great, and all producers of electric current will feel most insecure until the finding of the Court in this case has been reversed as no doubt it will be when heard before a Court which will go fully into the technical points involved. The plaintiff's witnesses swore that they saw the wires fire the building. Such a result would only be produced by a short circuit of course. The defendants showed that the fire alarm sent in by telephone by Dr. A. A. Macdonald, who saw the fire in the interior of the building, was given at 2.35, and the short circuit was recorded at the defendant's works as occurring at 2.48. The verdict was for $10,000 damages.

The whole of the evidence in this interesting case will be reviewed in a later issue.

ONTARIO RAILWAY GRANTS.

The following bonuses have been granted by the Ontario Government:

To the Ontario, Hudson Bay & Western Railway, between Missinabie Station on the Canadian Pacific Railway and tide-water on the mouth of Moose River on James Bay, a distance not exceeding two hundred and forty miles, a cash subsidy of $2,000 a mile—$480,000.

To the James Bay Railway, from a point at or near Sudbury to a point at or near Lake Abittibi, a distance not exceeding one hundred and seventy-five miles, a cash subsidy of $2,000 a mile—$350,000.

To the Haliburton, Whitney & Mattawa Railway, between Haliburton and Whitney, a distance not exceeding thirty miles, a cash subsidy of $3,000 a mile—$90,000.

To the Ontario & Rainy River Railway, from its junction with the Port Arthur, Duluth & Western Railway to Fort Frances, a distance not exceeding two hundred and five miles, a cash subsidy of $1,000 a mile, and from Fort Frances to the mouth of Rainy River, a distance not exceeding seventy-five miles, a cash subsidy of $4,000 a mile—$505,000.

To the Central Ontario Railway from Ormsby or Coe Hill to a point at or near Bancroft, a distance not exceeding twenty-one miles, a cash subsidy of $3,000 a mile—$63,000.

To the Central Counties Railway from Glen Robertson to Vankleek Hill, a distance not exceeding fourteen miles, a cash subsidy of $2,000 a mile—$28,000.

To the Ontario, Belmont & Northern Railway, from the northern terminus thereof in the direction of the townships of Belmont and Lake, a distance not exceeding seven miles, at the rate of $3,200 a mile—$22,400.

Resolved, That there shall be set apart for the use of the Sault Ste. Marie & Hudson Bay Railway and the James Bay Railway out of the lands of the Crown through which they may pass, 5,000 acres to the mile of each of the said railways for the portions above mentioned, such areas to be selected in blocks of 5,000 acres on each side of the line alternately by taking the necessary number of lots as the townships are surveyed or outlined, or by taking the proportionate grant for each ten miles of railway (or 50,000 acres) in blocks on alternate sides of the line, such blocks to have a frontage on the line of ten miles each, or in such other way as may be agreed upon by the said company and the Lieutenant-Governor-in-Council.

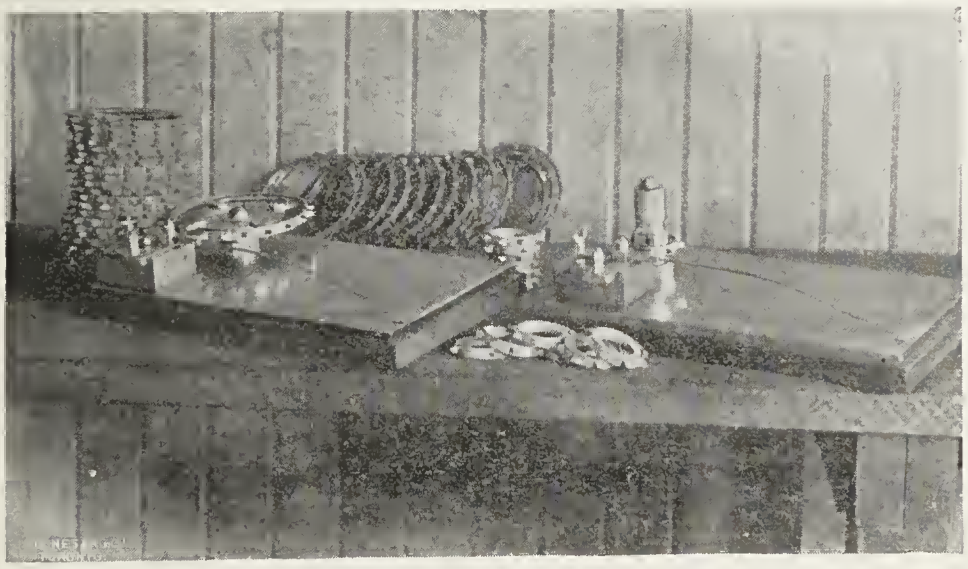
THE BICYCLE INDUSTRY.

During the last five years Canada has come to the front in a remarkable way in the bicycle industry. Last year this journal gave several instances of large shipments of Canadian-made bicycles to foreign countries and the British colonies, as well as to Great Britain itself. That Canadian manufacturers are doing their best to maintain their position in this branch of trade was made evident to a representative of The Canadian Engineer, who in company with a number of other journalists paid a visit the other day to the bicycle factory of H. A. Lozier & Co., Toronto Junction, makers of the Cleveland wheel. The extensions built to these works during the past year have enabled this company to double its output—which is now from 150 to 200 wheels per day. The various departments have an aggregate floor space of 137,000 square feet, and with the exception of the wood rims and rubber goods all parts of the Cleveland wheel are made in the firm's own works. In addition to its own steam plant the company has its own electric lighting plant, and its own gas plant, supplying fuel oil and gas for various departments. There are two oil tanks with a capacity of 5,000 gallons each. The works have their own water supply also, there being a roof tank of 10,000 gallons capacity, and an underground tank of 100,000 gallons capacity. The brazing of the bicycle frames is carried out chiefly by the "dip" process, ensuring uniform and rapid work. For removing the borax and encrustations the sand blast is used instead of the "pickle," commonly applied after brazing. The sand blast has the advantage not only of rapidly and completely cleaning the brazed parts, but the fine frosting which it gives to the entire frame enables the rust proof coating and subsequent enameling coats to adhere with greater tenacity. A view of the sand blast room is here given. It contains five sand tanks, to each of which is attached a pipe ending in a funnel which discharges the sand in a thin stream on the principle of a sand hour-glass. An air compressor supplies the air blast to each operator through a flexible tube which ends in a nozzle, manipulated by the operator as the nozzle of a fire hose would be. The operator's eyes are protected from the rebounding particles of sand by a canvas screen in which a pane of glass

Sand Blasting Department.

is fitted to enable him to see his work. Armholes are cut in the canvas so that he can hold the frame with one hand, and direct the stream of sand by means of the hose in the other hand. The blast of air is brought in under a pressure of 15 lbs., this being sufficient to drive the fine grains of hard sand with such force as to impart a fine frosting on the smooth tubing almost instantly. This is a hard silicious sand, imported from St. Louis, the Missouri sand being the best yet discovered for the purpose. Previous to being enameled the frames are primed with a special rust-proof composition. The enameling room has four double "dips," each tank holding 120 gallons of the enamel, and there are 10 furnaces, heated by fuel oil to a temperature of about 340 degrees for the baking of the enamel, which is put on in four coats. The blue dipping room for putting on the blue dip, which is the distinguishing feature of the Cleveland spokes, has a capacity for dipping spokes in lots of 5,000 at a time. A great amount of special machinery is used for the rapid production of the various parts of wheels, such as the pedals, cranks, hubs, chains, gear wheels, etc., and each part as it is completed is tested by automatic machinery, except the pedal cranks, which are tested by hand. For instance, a chain when finished is put into a device (shown in the engraving), by which it is subjected to a strain of 1,000 lbs. by means of a weight. Having been thus tested for strength the chain is put on a pair of sprocket wheels revolving at such a rate as would be equal to a run of 200 miles in a few minutes, and thus every link is put in the most thorough running order. So with the pedals, which after being put together are placed on the testing machine, here illustrated, and spun in a bath of oil at the rate of 3,000 revolutions per minute to prevent any possible unevenness. The machine tool room is very completely equipped. It contains a planer, 5 shapers, 2 milling machines, 15 lathes, 1 speed lathe, 50 vises, 1 die sinker, 1 universal grinder, 1 cutter grinder, 6 drill presses and many other machines; while the milling, drilling and punch press room contain 24 plain and universal machines, 15 drill presses, 10 punch presses and other special machines. The lathe department contains 21 screw machines, 10 lathes, 3 grinders and other machines. The air compressor used is from the well-known works of the Canadian Rand Drill Co., Sherbrooke. The company employs at Toronto Junction 350 to 500 hands, but the hands in the United States and Canadian works aggregate over 2,000, with a total production of 500 wheels per day. The works are under the able management of E. R. Thomas.

Drop Forging Department.


Sprocket Testing.

Chain Testing Machine.

Signor Cuigliemo Marconi, the inventor, who recently, after long delay, obtained permission from the French Government to establish a station on the French coast for the purpose of experimenting with wireless telegraphy between England and France, announces that he has conducted successful experiments between the South Foreland, county of Kent, and Boulogne-sur-Mer, 32 miles. The Times, March 29th, printed a hundred-word despatch, the first press message by the Marconi system of wireless telegraphy, describing the experiments between the South Foreland and Boulogne-sur-Mer. The experiments were carried out in the Morse code, and were read as distinctly as if wires were used.

J.L. JONES ENG. CO.
Crank Testing.

Industrial Notes.

Toronto is advertising for tenders for a gas plant for Toronto Island.

The Niagara Falls Planing Mill Co., Ltd.; capital, $3,500, has been incorporated.

The town of Windsor, N.S., has voted $2,000 for a site for a public building; $5,000 for the building and $5,000 for a steam fire engine.

The Dodge Mnfg. Co., Ltd., Toronto, is working a large staff of employees full time, turning out pulleys and rope drives, etc.

Vancouver, B.C., has ordered a No. 5 Champion rock crusher with elevator and screen from the Good Roads Machinery Co., Hamilton, Ont.

Shurley & Dietrich, Galt, Ont., have, it is said, decided to move their iron bedstead factory, now at St. Catharines, to Galt shortly. A new building will be erected.

The R. Simpson Co., Ltd., department store, Toronto, has bought the corner of Richmond and Yonge streets, and will build a large extension to the store at once.

Listowel, Ont., is organizing a co-operative pork packing establishment, whose proposed capital is $37,500, and also a furniture factory to be heavily bonused by the town.

Tenders are called for the construction of a system of waterworks for the village of Hintonburgh, Ont., as will be seen by reference to the advertisement in another column.

The Middleton, N.S., Outlook reports that the people of Berwick, N.S., are considering the advisability of starting a cannery in connection with the creamery already established there.

The McClosky Wire Fence Co., Ltd., Windsor, Ont., has been incorporated with a capital of $40,000. The provisional directors are: W. McClosky, J. R. Dixon, J. A. Auld, S. A. King, M.D., and J. Kay.

J. O. C. Mignault, C.E., has entered an action claiming $5,000 damages from the corporation of Roberval, Que., on account of a protest served upon him in connection with certain work which he did for the municipality.

W. H. Comstock, J. McL. Gill, G. I. Mallory, E. W. McCrea, O. K. Fraser, Brockville, Ont., and J. Cumming, Lyn, Ont., have been incorporated as the Brockville Peat and Power Company, Ltd.; chief place of business, Brockville, Ont.; capital, $99,000.

H. P. Dwight, W. D. Matthews, R. Jaffray, E. B. Osler, G. A. Cox, Fred. Nicholls and J. K. Kerr, Toronto, are the directors of the Motor Carriage Co., of Ontario, Ltd., which has been organized to make, and sell, and let for hire motor carriages and other vehicles; chief place of business, Toronto; capital, $250,000.

The Montreal Pipe Foundry Company, together with C. A. Meissner, have leased the works of the old Londonderry Iron Company, situated in Colchester county, N.S. The new company will, like the old, manufacture cast-iron water pipe and other cast-iron fittings. Mr. Meissner was the general manager of the old concern.

The B. Greening Wire Co., Hamilton, Ont., has just closed a contract for the erection of a new wire cleaning house, which will enable it to greatly increase the output of the wire drawing mill. During the building of this addition there will be added thirty feet to the smoke-stack, it being the intention to increase the power by the addition of 100 h.p., either electric or steam, as may be decided.

The reports of the British Fire Prevention Committee continue to be of great interest. No. 14, just received, contains the statement of a test made by the committee upon a floor built by the Expanded Metal Co., Ltd., London. In this test a room lined with expanded metal lathing and floored with concrete laid upon expanded metal, withstood a temperature of 2,000 deg. for an hour, and only showed slight cracking when water was thrown from a hose at 20 lbs. pressure for three minutes.

E. H. Bronson, F. P. Bronson, W. G. Bronson, Levi Crannell, Ottawa; T. L. Willson, Woodstock, Ont.; J. Sutherland, M.P., Woodstock, and J. J. Gormully, Ottawa, are applying for incorporation as the Ottawa Carbide Company, Ltd., to manufacture calcium carbide at Ottawa, with a capital of $200,000. It is said that the large sawmill premises of Bronson & Weston with its valuable water power will be used for the purposes of the company.

R. M. Thompson, New York; J. J. Thompson, Bayonne, N.J.; J. R. Wilson, Montreal; C .C. Colby, Stanstead, Que., and R. G. Leckie, Esq., Truro, N.S., are applying for a Dominion charter as the Canada Mining and Metallurgical Company, Ltd., to carry on exploring for mining, smelting, treating, manufacturing, extracting, reducing and selling gold, silver, copper, lead, iron, tin and other ores, metals and mineral substances. Chief place of business, Montreal; capital, $5,000,000.

The Fairbanks Co. has placed a large stock of its scales with Miller, Morse & Co., of Winnipeg, who will handle Fairbanks' standard scales, gasolene engines, and some of the other specialties of the Fairbanks Co. for Manitoba and the Northwest Territories. They will constantly carry in stock a full assortment of goods most commonly called for, and all enquiries for these products for this territory should be sent to them. The Fairbanks Co. is extending its business rapidly and while covering new territory accounts for some of the increase, the satisfaction experienced by former clients is a much greater source of the firm's development.

The Dominion Iron & Steel Company has been granted by the Nova Scotia Legislature a partial exemption from payment of royalty on coal used in the operations of the company, which has just been incorporated with a capital of $20,000,000. H. M. Whitney, Boston, who is head of the new company, as well as the Dominion Coal Company, asked for entire exemption from payment of the provincial royalty for a period of five years on the coal used by the Iron & Steel Company, and the Government granted half the exemption for eight years. The Dominion Coal Company pays a royalty of twelve and a half cents a ton. The Dominion Iron & Steel Company will use enormous quantities of coal.

Electric Flashes.

A. and G. Cornell are establishing an electric light plant at Stanbridge East, Que.

Quyon, Que., is to have electric light and a large grain elevator in the near future.

The Richelieu & Ontario Navigation Co. is placing a lighting plant in its hotel at Tadousac.

The Welland-Vale Co., St. Catharines, has recently installed a lighting plant in its bicycle factory.

The electors of Winnipeg will vote this month on a by-law providing for a municipal electric light plant.

The Canadian General Electric Co., Ltd., is installing an 800 light alternating dynamo for Jas. Knox, of Stayner, Ont.

The Montreal Novelty Co. has placed an order with the Canadian General Electric Co. for a 6 k.w. Edison generator.

The Radial Railway repair shops at Hamilton Beach were destroyed by fire, March 13th; damages, $4,500; fully insured.

The University of New Brunswick has purchased an experimental electric plant from the Canadian General Electric Co., Ltd.

Jos. Knot, Stayner, Ont., proposes to develop power on the Nottawasaga river for lighting and industrial purposes generally.

A project is on foot to build an electric railroad between Trenton and Westville, Pictou county, via New Glasgow and Stellarton.

The people of Cornwall, Ont., are making strong representations to the Government to secure an effective head of water for power development in the improvements being made in the Farran's Point canal.

The award in the Brantford, Ont., Electric Co. and Robson Bros. arbitration has been handed down and gives Robson Bros. $4,195.

The Penman Mnfg. Co., of Paris, Ont., is adding an 8½ k.w. generator of the Canadian General Electric Co.'s make to their present plant.

Cunliffe & Ablett, Vancouver, B.C., have bought from the Canadian General Electric Co., Ltd., two 50 h.p. three-phase induction motors.

The Hull and Aylmer, Que., Electric Railway Company has decided to equip its cars with new gearing so that they will run at forty miles an hour.

The Guelph Street Railway Co. has placed an order with the Canadian General Electric Co., Ltd., for a multipolar railway generator of 110 k.w. capacity.

The Montreal Street Railway Co. has placed an order with the Canadian General Electric Co., Ltd., for ten more two motor G.E. 1,000 motor equipments.

The street railway line is to be extended to English Bay beach, the Vancouver city council having granted the necessary franchises renewable every five years.

The Department of Railways and Canals has placed an order with the Canadian General Electric Co., Ltd., for additional plant to be used on the canal at Sault Ste. Marie, Ont.

The Kootenay Standard Publishing Company, Rossland, B.C., is placing in its printing house one of the Royal Electric Company's "S.K.C." induction motors to operate the printing presses.

F. H. Daigneault, M.D., J. E. Marcile, L S. Plamondon, E. St. Amour and E. Tetreault, Acton, Que., have been incorporated as the Acton Hydraulic Power Co., with a capital of $15,000; headquarters at Acton.

The Kentville, N.S., Electric Light and Power Co. is installing, as an increase to the present plant, two multipolar generators of 45 k.w. each, which will be supplied by the Canadian General Electric Co., Ltd.

The Lindsay Light, Heat & Power Co. has placed an order with the Canadian General Electric Co., Ltd., for one multipolar generator of 25 k.w. capacity, which is intended as an addition to the present power plant.

It is stated that the various electric companies doing business in Montreal in lighting, power distribution and passenger transportation, will be amalgamated with a probable capital of ten or fifteen million dollars.

The Richelieu & Ontario Navigation Company are installing complete lighting outfits on two of its boats, consisting of Canadian General Electric Company's multipolar generators of 30 k.w. capacity directly connected to high speed engines.

The Canadian Brotherhood of Electrical Workers elected the following officers for the year at a recent meeting in Toronto: President, T. Eaton; vice-president, S. P. Kent; recording secretary, J. C. Long; financial secretary, F. Marson; treasurer, F. Hawkey.

W. A. Johnson, J. W. Thompson, J. N. Smith, G. E. Scholey, Erie Thompson, C. J. Holman and A. B. Lee, Toronto, have been incorporated as the United Electric Co., Ltd., to carry on the business of the W. A. Johnson Electric Co., and the Toronto Electric Motor Co., Ltd.

A. S. Bowen, Kemptville, Ont., has purchased the lighting plant recently operated by Mr. Collins of that town, and is installing a standard 1,000 light alternator of the Canadian General Electric Co.'s make, together with a complete new transformer and arc lighting system.

The T. Eaton Co., Ltd., Toronto, has given the Canadian General Electric Co., Ltd., a contract to supply another 130 k.w. 110 volt direct connected generator, as an addition to its already extensive plant. This company will now have probably the largest and most modern isolated plant in Canada.

The Montreal Cotton Co., Valleyfield, Que., is constantly increasing its large electric transmission plant, of which the three-phase induction motor is found so satisfactory for cotton mill operation. There have recently been ordered from the Canadian General Electric Co., Ltd., three motors of 75, 50 and 10 h.p., respectively.

Local capitalists propose to subscribe the funds for the talked of Guelph-Hespeler electric railway.

An electric light plant has been added to the Standard Chemical Co.'s equipment, Deseronto, Ont.

The proposed Galt, Preston and Hespeler Railway would enter Galt via Doon and Blair and connect with the C.P.R.

The Montreal Cotton Co., of Valleyfield, Que., has ordered another 100 h.p. induction motor from the Canadian General Electric Co.

The Dominion Coal Co. proposes doing away with the horses used in the mine for hauling purposes, and will use electricity entirely.

The London Electric Light Company, Ltd., has secured an amendment to its charter increasing its total capital stock from $250,000 to $500,000.

The Canadian General Electric Co. has received an order from Stunden & Perrine, of Rossland, B.C., for a standard induction three-phase motor.

The Montreal Island Belt Line Co. is applying for increased powers in building branch lines, and to buy the Chateauguay and Northern Railway Co.

Jno. Forman, Montreal, has sold his property, 565 acres, at Shawinigan Falls, to the Shawinigan Water & Power Co., and the development will now proceed.

The Brantford Street Railway Co., Brantford, Ont., is installing six Canadian General Electric "800" railway motors, purchased from the Canadian General Electric Co.

The Canadian Pacific Railway Co. has placed an order with the Canadian General Electric Co. for one 75 k.w. three-phase synchronous motor for the Trail smelter, Trail, B.C.

The Winnipeg Electric Street Railway Co. has placed an order with the Canadian General Electric Co. for two additional Canadian General Electric "1,000" 2-motor equipments.

The National Electric Co., 1586½ Notre Dame street, Montreal, is the style of a new firm commencing business as electrical contractors, and making a specialty of installation for electric lighting.

The linemen of the construction department of the Hamilton Electric Light and Power Company recently struck for an increase from $8.50 to $10.50 per week for experienced hands. The demands of the men were granted.

A verdict for $4,000 damages was given against the Toronto Railway Co. recently for damages sustained by a Mrs. Darling, who fell and broke her leg, owing to the street car beginning to move while she was getting off.

The Canadian General Electric Co. is supplying the Hospital St. Jean de Dieu of Longue Point, Que., with a motor equipment of the standard Canadian General Electric 1,200-motors, including controllers, rheostats, etc.

The Electrical Maintenance and Construction Co. of Toronto, Ltd., has been formed by P. H. Patriarche, P .D. Ball, H. L. Dunn, W. M. Boultbee and others, of Toronto; capital, $20,000; chief place of business, Toronto.

The Dominion Oilcloth Co., of Montreal, has placed an order with the Royal Electric Co. for the complete equipment of its factory with "S.K.C." motors. The different units as required throughout the building in the different departments, aggregate over 150 h.p.

Hamilton, Ont., is understood to be the home of a large electrical combine similar to that alleged to exist in Montreal. The plan includes all the electrical plants in Hamilton, light, power and trolley, and is said to have designs on the Cataract Power Co., and the electric lines at Niagara Falls.

The Esquimalt & Nanaimo Railway Co., which is opening up its coal mines at Oyster Harbor, B.C., has decided to operate the entire mining and hauling apparatus by electricity, and for this purpose has placed their order for two direct connected units of 150 h.p. each, with Ideal engines, and two 40 h.p. mining locomotives with switchboards, and all the necessary supplies for the complete installation, with the Royal Electric Co. of Montreal. This is the second order that the Royal Electric Co. has received for mining locomotives and apparatus on Vancouver Island.

Joliette, Que., is extending its arc system, and has placed an order with the Royal Electric Company for a 50-light 2,000 c.p., T.H. Royal arc machine, with a full equipment of lamps. This is an addition to a recent purchase of an 120 k.w. "S.K.C." generator with transformer, etc., which was put in operation recently.

The Consumers' Cordage Co., of Montreal, is fitting out its factories with electric power and has placed its order with the Royal Electric Co. for two 50 h.p. "S.K.C." synchronous motors. The current for these motors is to be furnished by the Chambly Mnfg. Co. as soon as it has their current in the city, which is expected about the first of May.

The Montreal Street Railway Company is building a hundred new open cars for its summer service. One improvement is a safety board of wooden sheeting on the side of the car nearest the other tracks, instead of the wire screen, as formerly; the cotton cover intended to keep out rain is replaced by waterproof blinds, which fit tightly into frames.

A company to be known as the Nova Scotia Electric Light Co. is being organized to furnish electric light, heat and power to all points in the valley from Windsor to Annapolis, with branches to Canning, Kingsport, Granville Ferry and other outlying centres. The source of power will be the Gaspereau river, where there will be an effective head of water of 375 feet with a minimum flow of 8,000 cubic feet. F. B. Wade, Q.C., and C. E. Foss, are the organizers of the company.

The bill respecting the Hamilton, Chedoke and Ancaster Street Railway Company was passed by the Railway Committee of the Ontario Legislature with one amendment, which provides that the road may be run by electricity or compressed air but not by steam. The capital stock is raised from $100,000 to $300,000, and the line will in future be known as the Hamilton, Ancaster and Brantford Railway. An agreement may be made with the Brantford Street Railway for the use of its tracks.

The Riordon Paper Mills Co., Hawksbury, Ont., is lighting its plant throughout by electricity. An order has been placed with the Royal Electric Company, Montreal, for a 25 k.w. "S.K.C." two-phase generator, wound to deliver 110 volts. There will be 200 incandescent lamps installed from this throughout the mills, as well as ten alternating enclosed arc lamps. This is the fifth large mill or factory which has within the past year installed alternating current apparatus of the "S.K.C." two-phase type.

John Ross Robertson, of The Telegram, in laying out his new buildings at the corner of Bay and Melinda streets, Toronto, is arranging for a most complete electrical installation. All the printing machinery, shafting, hoists and elevators are to be operated by electricity as well as the lighting of the building throughout. The Goldie, McCulloch Co., of Galt, Ont., are furnishing the steam engines and boilers; the Sprague Electric Co. are furnishing the hoists and elevators, and the Canadian General Electric Co. is supplying the generators and slow-speed motors for lighting and power. A more detailed account of this ideal installation will be given in a later issue.

The regular annual convention of the Maritime Electrical Association will be held in Halifax, April 18th. The convention headquarters will be at the New Victoria Hotel, and the meetings will be held in the assembly room. The programme will be as follows: 9.30 a.m., meeting of the Executive Committee; morning session, 10 a.m., president's address, report of secretary-treasurer, report of committees, election of officers, general business. Afternoon session, 2 p.m., papers will be read by members on Iron Armoured Conduit Wiring, Fire Alarm Systems, Steam Engineering, Telephone Work and Electric Meters. Questions which have been suggested by the members will also be discussed. In the evening a reception, consisting of banquet and smoking concert, will be tendered by the Halifax members of the association. The president, F. A. Bowman, states that no effort is being spared to make this convention a success from every point of view; and all members attending will not only receive some very practical information from the papers to be read and the discussions which will follow, but will also find the occasion a most enjoyable one socially.

At the annual meeting of the Canadian General Electric Company all the old directors who are eligible were re-elected. The following comprise the board for the present year: W. R. Brock, president; H. P. Dwight, first vice-president; Frederic Nicholls, second vice-president and managing director; Hon. Geo. A. Cox, W. D. Matthews, Robert Jaffray, E. B. Osler, J. K. Kerr, S. D. Greene, E. W. Rice, jun., and H. Parsons.

The Folger-Hammond Mines Co. has given a contract to the Canadian General Electric Co., Ltd., which covers the installation of a complete transmission plant to operate their stamp mills and compressors from a water fall some three miles distant from the line. The generating plant will consist of a three-phase generator of 150 k.w. capacity, operating at 2,000 volts. For operating the machinery there will be supplied one 100 h.p. three-phase induction motor and one 20 h.p.

F. Richardson, assistant electrician of the C.P.R., accompanied by M. Grimes, Ottawa, and a staff of assistants, left early last month for the Pacific coast under instructions from the Minister of Public Works, to construct a telegraph line from Skaguay to Dawson. The estimated cost of the line for the distance of 600 miles between the two points named is $150,000. It is expected that the line will be in operation by the 15th of November. Whether the sea link will subsequently be connected by a cable between Vancouver and Skaguay, or whether the Government line from Quesnelle, in the Cariboo country, will be extended northward to connect with the Skaguay-Dawson line, has not been made known.

The specifications on which the Central Construction Company was awarded the contract for the power plant at Orillia, Ont., provide for a solid masonry dam, laid in cement. There are two steel flumes, with an opening in the dam for a third. The power house, which is to be fire-proof, will be 62x36. The company also undertakes to cut down all trees along the route, to furnish two motors for the present plant, one for the pumps and one for lighting plant. The Westinghouse Company is supplying the electrical machinery; the Stillwell-Bierce and Smith-Vaille Company the wheels. The Central Construction Company gives a bond of $12,000 from the National Security Company, good for sixteen months (which will carry the town over the freshets of the spring of 1900), that the dam, etc., is of sufficient strength, and one of $5,000 for four years.

Judge McDougall, in a judgment delivered March 27th, upheld the conviction of the Toronto Railway Company for a breach of the city by-law which provides that every railway operating within the limits of the city shall, during the months of January, February, March, November and December, provide each car with a proper and sufficient vestibule to protect the motorman and others in charge of the car. His Honor held that the meaning and interpretation of the by-law is plain, and the conviction should be affirmed, and the appeal dismissed with costs. He found that the evidence showed that the conductor and motorman were in charge of the car within the ordinary meaning of the expression. His Honor added: "As to the argument that the rear-end vestibule would interfere with the proper working of the car, it should be addressed to the city council." His Honor also found that the objection raised as to the alleged application of the Dominion Railway Act, owing to the fact that the Street Railway Company's tracks crossed the tracks of the G.T.R. and C.P.R., was not sustained.

Personal.

William Clare has been appointed to the charge of the East End sewage disposal works, Hamilton, Ont.

Horace Mabee, a graduate of the Kingston School of Mines, has been appointed chemist of the Deseronto Iron Co.

Samuel Hall, one of the oldest employees of the G.T.R., Belleville, died last month. He was 25 years an engineer, and for twenty years had charge of the pump house in Belleville.

Thos. Potter, in charge of the electric lighting plant, Walkerton, Ont., received a shock at 1,000 volts last month, and was severely injured though not killed. He was sitting reading a newspaper, and leaned back in his chair till his head came in contact with a wire.

Geo. A. Calvert, who represents the Fairbanks Co., Montreal, Fairbanks' standard scales, asbestos disc valves, etc., called upon us recently while in Toronto.

C. J. Peppin, night watchman in the Parliament Buildings, Toronto, has been appointed engineer at the Deaf and Dumb Institute, Belleville, Ont. The position carries with it a salary of $600 and house rent free.

Near Millwood station on the Manitoba and Northwestern railway the engineer, W. Hill, and the fireman, P. Donlon, were instantly killed, March 6th, by the explosion of the locomotive boiler, while working up a steep grade.

Joseph Chartier, thirty years of age, a wire drawer in the Dominion Wire Works, Lachine, Que., while at work became entangled in a mass of wire, which drew him into a cutting machine, with the result that his left foot was almost completely severed.

The death took place in St. Thomas recently of William Chambers, ex-locomotive foreman of the Grand Trunk shops. Mr. Chambers was born in England in 1828, and on coming to Canada entered the employ of the G.T.R. in 1854, and only left its employ in 1888.

Joseph R. Roy, C.E., resident engineer-in-chief for the Dominion Government in British Columbia, who has been for some weeks in Montreal recuperating from a severe illness, has gone in charge of a party sent by the Dominion Government to Dawson City, in the Yukon, to make some surveys and carry out needed public works.

The scaffold erected inside of a large sawdust burner for the purpose of repairs at the mills of W. C. Edwards & Company, Rockland, Ont., gave way just as the men were entering at 1 o'clock, March 20th, and coming down upon the five who entered, killed four of them. The dead are: Louis Rochon, Henry Dalrymple, Eugene Deschamp, Archie Stewart. Xavier Frappier was four hours under the debris and was finally got out seriously hurt.

At a meeting of the Can. Assoc. Sta'ry Engineers, Montreal No. 1, held shortly after the death of Capt. Jas Wright, an honorary member of the association, many expressions of regret were made by the members at the loss of an earnest and faithful friend. A motion of condolence and sympathy was unaniously passed, and the meeting adjourned immediately out of respect to his memory. Capt. Wright was one of the oldest and most reliable mechanical engineers in the country, was for many years superintending engineer of the dredging plant of the Montreal Harbor Commissioners.

It is announced that the Joule scholarship for physical research has been awarded by the council of the Royal Society, London, to Howard T. Barnes, M.Sc., demonstrator in the Physics department, McGill University, Montreal, and whose training has been received at McGill. The annual value of the scholarship is a hundred pounds, and it is generally awarded for two years. Mr. Barnes will continue the researches into the specific heat of water on which he has been for some time engaged.

The death took place recently at Albany, N.Y., of Arthur S. C. Wurtele, C.E. The deceased, who was 69 years of age, was the second son of the late Jonathan Wurtele, seigneur of River David, and was born at Quebec. He studied civil engineering with Walter Shanly, C.E., and afterwards received an appointment as one of the resident engineers of the New York Central Railway. He was next appointed deputy state engineer of the State of New York. He retired a few years ago, having gained an excellent and widespread reputation as an engineer.

F. H. Badger, only son of Mr. Badger, Montreal, city electrician, died a short time ago at his father's residence, Montreal. Deceased, who was 36 years of age, was an expert electrician and for many years in the service of the Royal Electric Company, having charge of the outside work and installing the company's present wire system. Some four years ago he went to Quebec to take charge of the Montmorency and Quebec Electric Light system. On the amalgamation of that system with the Quebec Street Railway Company, last year, he went to New York, where he has since been engaged. He was offered his choice of two good positions, one in Washington, D.C., the other in St. Paul, Minn. Before deciding which to accept he determined to visit both places. After doing so he decided to accept the post in Washington, but was suddenly taken ill. When he was at Washington the weather was mild, and he wore light clothing. When he reached St. Paul the thermometer stood at 45 below zero, and he caught a severe cold, which had developed into pneumonia by the time he reached Montreal, and resulted, as stated, in his death.

F. G. Beckett, Hamilton, Ont., died very suddenly at Inglewood, N. J., last month. Grip was the cause of death. Deceased went to Inglewood in January to visit a married daughter. He was about 70 years of age, and was well known in Hamilton for almost half a century. Many years ago he had an engine works where the cotton factory now is and did a big business during the oil fever. He manufactured engines and boilers for the big freight ferry boats which ply between Windsor and Detroit. Later he was in partnership with J. W. Killey, and had works on Barton street. For some years he has been before the public as the promoter of the Beckett drive, along the mountain side.

There was a big sensation in civic circles in Ottawa last month. Early in March Assistant City Engineer Perreault was suspended for making errors in measurements. A little later City Engineer Galt was advised to reinstate him, but Mr. Galt, having previously been given full power to deal with his subordinates as he thought proper, called for Mr. Perreault's resignation. This angered Mayor Payment, whose friend Mr. Perreault is, and the mayor suspended Mr. Galt for "having usurped the authority of the council," and placed Mr. Perrealt in charge. The city council promptly resented this action on the part of the mayor and appointed a new assistant engineer.

J. T. Nicolson, head of the department of Mechanical Engineering at McGill University, Montreal, since 1891, has resigned on account of receiving an Appointment in Manchester, Eng., as head of the Mechanical and Electrical Departments of the Municipal Technical School there. For his experiments in compression, which threw added light on geology, and for his work with Prof. Callender in preparing the paper on the steam engine read before the Institute Civil Engineers, Great Britain, in 1897, Mr. Nicolson has received well-merited honors. For the paper Mr. Nicolson was awarded the Watts gold medal and a Telford premium of £20, by the Institute of Civil Engineers, London, and for the two researches he obtained the degree of D.Sc., from Edinburgh last summer.

Early on the morning of March 7th A. Galloway, foreman of a gang of men at the Imperial Oil Company's works, Sarnia, Ont., ordered some of his men to clean out one of the oil tanks in the company's yards. James McCue proceeded down into the tank. When he reached the bottom he was seen by his fellow workmen to fall down. Another workman named John Carter went down to rescue McCue, but no sooner reached the bottom of the tank than he too was overcome by the gas. The foreman, Galloway, was the next to attempt the rescue of the men, and he shared the same fate as the preceding two men. Henry Willis then came to the unfortunate men's rescue, but he, too, was overcome, as was also another employee, named William Brimbs. By this time the alarm had been given that some men were being smothered in a still, and a gang of men from the boiler-shops were soon on the scene and proceeded to tear the covering from the still to allow the gas to escape, and thereby make it safe for men to descend into the still. Before this work was completed William McCue attempted to go down the ladder, but when half-way down he fell, being almost overcome, but managed to climb part way up again, and was pulled out of the still just in time, as he fainted when he reached the ground. After the covering had been torn away, and the gas allowed to escape, other employees went into the still, and the five men who were lying in a heap at the bottom were hoisted to the top, and all that was possible was done for the unfortunate men. Doctors, who were hastily summoned, worked over the poor fellows from that time until late in the afternoon, when their efforts were finally successful. The courage of the men who went down to face what seemed probable death one after another cannot be too highly praised.

Marine News.

Matthew's Line, Toronto, Ont., has appointed to the steamers “Niagara,” Capt. Jas. Morgan, Engineer Thos. Mills; “Clinton,” Capt. John Fahey, Engineer J. M. Donaldson.

Alexander Horn, of Oldrieve & Horn, sailmakers, Kingston, Ont., has been notified of his appointment as Government inspector of hulls in succession to Thomas Donnelly, resigned.

Merchant's Line, G. E. Jacques & Co., Montreal, have appointed to the propellers “Cuba,” Capt. Henry Chestnut, Engineer William Kennedy; “Melbourne,” Capt. Fred. Elliott, Engineer Thos. Milne.

Lake Ontario & Bay of Quinte Steamboat Co., Kingston, Ont., has appointed to the steamers “Hero,” Capt. Wm. Bloomfield, Engineer Robt. McEwan; “North King,” Capt. John Jarrell, Engineer O. J. Hickey.

Canadian Pacific Steamship Co., Montreal, has appointed to the steamers “Manitoba,” Capt. E. B. Anderson, Engineer W. Lewis; “Athabasca,” Capt. G. McDougall, Engineer W. Lockerbie; “Alberta,” Capt. J. McAllister, Engineer Angus Cameron.

St. Lawrence & Chicago Steam Navigation Co., Ltd., J. H. G. Hagerty, mgr., Toronto, Ont., has appointed to the steamers “Algonquin,” Capt. James McMaugh, Engineer James H. Ellis; “Rosedale,” Capt. James Ewart, Engineer Ed. O'Dell.

Hepburn, A. W., Picton, Ont., has appointed to the steamers “Alexandria,” Capt. E. B. Smith, Engineer Chas. McWilliams; “Aberdeen,” Capt. M. Heffernan, Engineer Frank Theriauld; “Water Lily,” Capt. M. Hicks, Engineer George Gerow. Schooners “Rob Roy,” Capt. Homer Peron.

McKay R. O. & A. B., Hamilton, Ont., has appointed to the steamers “Sir S. L. Tilley,” Capt. W. O. Zealand, Engineer Joseph Boulanger; “Lake Michigan,” Capt. Arthur Lefebvre, Engineer Joseph Dawson; “Myles,” Capt. John S. Moore, Engineer Jas. Smeaton. Schooner “T. R. Merritt,” Capt. William A. Corson.

North Shore Navigation Co., Collingwood, Ont., has appointed to the steamers “City of Collingwood,” Capt. W. J. Bassett, Engineer Chas. Robertson; “City of Midland,” Capt. F. X. La France, Engineer Wm. Whipps; “City of Toronto,” Capt. John O'Donnell, Engineer D. McQuade; “City of Parry Sound,” Capt. Ernest Walton, Engineer J. L. Smith; “City of London,” Capt. W. W. Storey, Engineer Jas. Crossland.

The Richelieu & Ontario Navigation Co. has made the following appointments to the various steamers of the fleet for the season:

Steamer.	Captain.	Engineer.
“Quebec”	L. O. Boucher	F. Gendron
“Montreal”	L. St. Louis	F. X. Hamelin
“Canada”	J. Dugal	E. Denis
“Saguenay”	C. Lapierre	
“Carolina”	G. Riverin	M. Latulippe
“Three Rivers”	F. St. Louis	J. Matte
“Berthier”	C. Gouin	E. Arcaud
“Terrebonne”	F. E. Gouin	G. Gendron
“Chambly”	Geo. Paulch	C. Gendron
“Laprairie”	P. McLean	N. Beaudin
“Cultivateur”	O. Raymond	H. Noel
“Longueuil”	F. Jodoin	N. Beaudet
“Hochelaga”	H. Maudeville	F. Chapdelaine
“Hosanna”	D. Mongeau	E. Gendron
“Mouche-a-Feu”	— Crepeau	P. Boucher
“Sorel”	— Berthiaume	— Beaucage
“River-du-Loup”	— Faubert	L. Godin
“Toronto”	H. Esford	Wm. Black
“Spartan”	H. P. Grange	
“Algerian”	D. Mills	
“Bohemian”	A. Dunlop	A. R. Milne
“Hamilton”	A. J. Baker	L. Marshall
“Corsican”	John McGraw	Wm. Parker

Calvin & Co., Garden Island, Ont., have appointed to the steamers “D. D. Calvin,” Capt. A. H. Malone, Engineer T. C. Smith; “Bothnia,” Capt. G. A. Brian, Engineer R. Veech; “Armenia,” Capt. Chas. Coons, Engineer W. Cunningham; “Reginald,” Capt. John Doyle, Engineer J. Kennedy; “Chieftain,” Capt. John Sullivan, Engineer T. Gray; Parthia, Capt. David Lefavre, Engineer G. Sauve; “W. Johnston,” Capt. Ed. Phelix, Engineer T. Harper; “Bluchell,” Capt. John Dix, Engineer C. LeRiche.

At the meeting of representatives of the Canadian Marine Engineers' Associations of Toronto, Vancouver, B.C., and St. John, N.B., last month, in the Confederation Life Building, Toronto, it was unanimously decided to amalgamate the three distinct societies. About 60 delegates were present, and the chair was occupied by Harry Parker, president of the Toronto organization. At a meeting held in the morning of the visiting delegates, a report was drawn up and plans agreed upon for presentation before all the members. After three hours' discussion the entire meeting agreed on an amalgamation. Harry Parker, S. G. Mills and Robert Craig were appointed an Executive Committee, to meet in Montreal next autumn, and arrange a new constitution for the organization. The name will hereafter be the National Association of Canadian Marine Engineers, and it at present boasts of a membership of 350. Branches will also be instituted in Kingston and Montreal. The meeting then adjourned.

Brief, but Interesting.

The purchase of the Havana street railway by the Harvey syndicate of New York has been declared void by the Cuban courts, and the Canadian capitalists may now have an opportunity of exploiting the transportation facilities of the island.

Alternating current apparatus for all purposes is making progress in Canada, and it is said that before many months there will be alternating current street railway apparatus in use in Canada. It is already extensively used in Europe, especially in Switzerland, and the larger companies in the United States are experimenting with it, and have already built a new road entirely equipped with alternating current apparatus, which is giving satisfaction.

The most complete telephone system in the world has just been inaugurated in Stockholm, Sweden. It is not in the hands of a syndicate or a trust, but under the immediate control of the Government. There is hardly a residence in Stockholm and the neighboring towns not connected with central offices. The telephone tax is levied in the same manner as the water tax and amounts to only $5 a year. In this connection it is interesting to notice the large appropriations made at the present session of the British Parliament for the establishment of a Government telephone system in connection with the postoffice and in opposition to the private companies, whose inadequate service has been the cause of so much complaint on the part of the public.

H. W. Wood, instructor in physics in the University of Wisconsin, has originated the idea of thawing out water pipes with electricity, and has made successful experiments. He takes the electric current used for street lighting purposes, attaches one wire to the frozen pipe inside the cellar of one house and the other wire to a similar pipe in the adjoining or any other house, thus completing the circuit. A current of about fifty volts is then turned on, heating the pipes and melting the ice within. At Chatham, Ont., experiments in this method were made under the direction of Superintendent Jones of the Waterworks Department, and Manager Coate of the Gas Company. Two hydrants, 280 feet apart, were connected to the electric lighting circuit, and were thawed out in 45 minutes. Another hydrant, distant 129 feet from the first, was also connected, and thawed out in 24 minutes.

Ball bearings have been little used on heavy vehicles because it is difficult to make them endure the great pressure. A form of ball bearing devised by Schuppiser has been tried on street cars of Zurich, at first unsuccessfully, as in other experiments, but more satisfactorily since balls to take up side pressure have been employed in addition to those carrying the weight. In their present form, the bearings have two rows of sixteen ¾-inch balls, and two rows of twenty-six ½-inch balls each. To distribute wear, the bearings are arranged so that they can be moved into four different positions. Some of the bearings have now been under test more than two years, Podoski reports, but much trouble was at first experienced with the bearings for the balls. For a few months these have been made of Krupp's crucible steel, which is thought to have quite overcome the difficulty. It is found that an average saving of 15 per cent. of the total power has resulted on the four electric railways experimented on, and as high as 24 per cent. on one line, with 35 per cent. under the most favorable conditions. In every case a saving has been shown, even on steep grades.

Mining Matters.

It is reported in Quebec that gold yielding $20 a ton has been discovered near Lorette, Que.

Bonham & Munroe have commenced business as mining brokers with offices in Canada Life Building, Montreal.

A very rich strike of placer gold is reported from Tete Jeune Cache at the headwaters of the Fraser river, B.C.

The Newcastle Coal Co. at Port Morien, C.B., has given a contract for a considerable amount of mining machinery again.

The Crow's Nest Pass Coal Co. turned out 2,000 tons of coke from the oven at Fernie, B.C., in the month of February.

The Crow's Nest Coal Co. has secured the contract to supply the British fleet at Esquimault with coal for the present year.

A letter from A. P. Low, of the Geological Survey staff, which is wintering on Hudson s Bay, confirms previous reports of the existence of deposits of magnetic iron ore on the shores of the bay.

At the annual meeting of the Mining Society of McGill University Dr. Harrington was elected honorary president, Mr. McMillan was elected president, Mr. Cowans, vice-president, and Mr. Archer, secretary-treasurer.

It is stated that work will soon be started upon the erection of a 400-ton smelter at Greenwood, B.C. The capitalization of the company is $400,000, and J. P. Graves, prime mover of the Old Ironsides and Knob Hill, is the promoter.

The following gentlemen are interested in active mica mining near Kingston, Ont.: Kent Bros., bankers; E. H. Smyth, Q.C., I. Franklin, merchant; Mr. Chown, of the Webster Co., Sydenham, and J. L. Gemmill, Perth, Ont.

The zinc mine situated between Rossport and Schreiber on the C.P.R., about twelve miles from the mouth of the Gravel river, which was sold to a Belgian syndicate last year by Jno. McKellar, Fort William, Ont., is shipping freely to Belgium, where it is stated the ore nets almost $40 per ton.

W. C. Caldwell and T. B. Caldwell, accompanied by Arch. Blue, director of the Ontario Bureau of Mines, made a visit to the gold mines at Ardoch, Addington county, Ont., owned by the Boerth Mining Co., Detroit. A boarding house has been erected and some sixty men are at work. Five large furnaces and a pulverizer are used in reducing the ore, which has proved to be rich, assaying from $24 to $160, and $50 to $500 per ton. The mine is situated not far from the Kingston & Pembroke Railway, and is on the Mississippi river.

The lead and zinc deposits in Tudor township, Hastings county, Ont., are beginning to attract attention. The Hollandia and Catharine mines are said to have assayed very heavy values in lead and zinc. This is the first discovery of zinc in Hastings county, although its presence in the mineral belt was referred to about twenty years ago in a paper read by T. Campbell Wallbridge before the Royal Geological Society of London. One of the deposits is only ten miles from Millbridge on the Ontario Junction Railway.

The summer mining class of McGill University, which proved so successful last year, will be continued this year. The party will leave McGill, under Dr. Porter, about the 25th of April and will spend about four weeks in the work. This year they go to the United States and will visit the anthracite mines of Central Pennsylvania. Here they will be able to see some of the largest coal mines in America, and will be able to observe the railway transportation there carried on, as well as the actual mining operations. Exactly what mines will be visited is not yet definitely settled, but invitations have been sent to Dr. Porter from several mines.

Railway Matters.

One thousand freight cars are to be built by the C. A. and O. A. & P. S. Railways this year.

The Central Vermont Railway was bought at auction by a representative of the G.T.Ry., March 21st, for $7,000,000.

G. L. Mattice, Montreal, is engineer-in-charge of construction of the Rutland & Canadian Railway from Aldburgh to Novar Junction.

It is said that the C.P.R. will build a coal wharf and sheds at St. John, N.B., so that it may be in a position to send 200,000 tons of coal per annum to Montreal.

—The judicial enquiry into the composition of the reports on the efficiency tests of the Green's Economizer at the Toronto waterworks main pumping station is proceeding before Judge Macdougall. The city engineer has ended the state of hostilities among the staff at the high level pumping station by discharging the whole staff and appointing Wm. Hall from the main pumping station in charge, and Woodward, of the Niagara Nav. Co., and McKeown, G.T.R., to fill the vacancies.

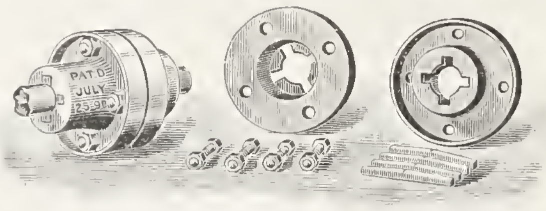
—The provisions of the Ontario Act dealing with the Niagara Power question rushed through by the Government at the end of the session are mainly two. The first provides that the Commissioners of Queen Victoria Niagara Falls Park may, with the approval of the Lieutenant-Governor-in-Council, enter into an agreement with the Canadian Niagara Power Company for the surrender by the latter of its sole right to use the waters of Niagara river within the limits of the park, upon such terms and conditions as to abatement of rent, extension of time for carrying out the agreement of 1892, variation of that contract, etc., and that any arrangement so entered into shall be binding. The second resolution provides, in brief, that the Park Commissioners may enter into contracts with other persons or companies to enable such persons or companies to use the waters of the Niagara within or without the park for power purposes, but it does not add, as in the case of the former resolution, that any such contract is to be binding.

FIRES OF THE MONTH.

March 3rd. J. Stuart's machine shop, Thorold, Ont.; damages, $18,000; insurance, $10,000.——March 12th. Hamilton Radial Railway Co.'s workshop, Hamilton Beach; damages, $5,000; fully insured.——March 22nd. Elliot & Brooks' paper box factory, Adelaide street west, Toronto; damages, $25,000; insurance, $16,000.——March 28th. G. G. Bryant's sash and door factory, Sherbrooke, Que.; insurance amounting to $6,300 will not cover loss.

THE NICHOLSON PATENT FLANGED FACE COMPRESSION SHAFT COUPLING.

The makers of this coupling claim for it that in design, construction and general operation, it more completely meets the requirements of a first-class shaft coupling than any other on the market. In appearance it resembles the ordinary flanged face coupling. The two half castings are bored tapering, and have flanges on rim to cover bolt heads and nuts. The outer faces of hubs are closed almost to shaft by a rib or projection, through which slots are cut to space the jaws a uniform distance apart and hold them in position while coupling is being fixed on the shaft. The steel jaws have double taper, turned to fit bores of castings, and are concaved on their inner faces a trifle less than the radius of shaft, which makes the grip positive when flanges are drawn up by the bolts. The couplings are fitted so that flanges stand from ⅜ to ¾ of an inch apart when drawn tight with the bolts, thus enabling a trifle larger or smaller size of shaft than gauge to be coupled. Owing to this feature extra couplings may be carried in stock, so that in case of an accident they can be immediately applied to the shafts that have been broken and twisted off, or another shaft may, it is stated, be coupled on without the necessity of key seating the old shaft or making exact measurements to ensure a perfectly tight fit. The Nicholson patent flanged shaft coupling is placed on the market by the Fairbanks Co., Montreal, and is, we are told, being installed by the company in place of less up-to-date appliances.



CANADIAN PATENTS.

The following patents of interest to engineers were issued in January:

No. 62,176.—Electric arc lamp; The British Blahnick Arc Light Co., Westminster, London, England.

No. 62,177.—Rail joint for electric railways; The firm of Ausfuhrungenfur Eisenbahn, Oberban; Abtheilung "Stossfangschienne," Seigm, Eppenstein, of 45 Wilhelmstrasse, Berlin, Germany.

No. 62,181.—Acetylene gas generator; Isidore Therien, Quebec, Que.

No. 62,186.—Acetylene gas generator; Francis Xavier Nadon, Maniwake, Que.

No. 62,194.—Acetylene gas generator; E. J. Dolan, Philadelphia, Pa.

Nos. 62,199, 62,200, 62,201.—Motor; Zdzislav Maevsky, St. Petersburg, Russia.

No. 62,203.—Acetylene gas generator; J. W. Scarth, Pudsley, York, England.

No. 62,207.—Turbine; Jos. Chew, Orillia, Ont.

No. 62,214.—Telephone transmitter; F. A. Ray, Boston.

No. 62,217.—Railway rail joint; T. C. H. Gray, Gray Bridge, Mass.

No. 62,219.—Trolley connection for canal boats; F. J. Shewring, Toronto.

No. 62,224.—Solenoid blow-out for displacing, dispersing, or extinguishing, formed in breaking electric circuits; S. H. Short, Cleveland, O.

No. 62,243.—Drill clutch; W. L. Hirlinger, Luzerne, Penn.

No. 62,249.—Device for moving dredging machines; J. W. Pike, Vancouver, B.C.

No. 62,262.—Insulator; E. Renault, Florida, U.S.A.

No. 62,264.—Electric arc lamp; Thos Spencer, Philadelphia, Pennsylvania.

No. 62,269.—Smokeless furnace; Ed. Gessner, No. 60 Krona, Brunn, Austria.

No. 62,278.—Railway tie and clamp; Chas. A. Cole, New York.

No. 62,281.—Acetylene gas making machine; A. Holland, Ottawa, Ont.

No. 62,282.—Acetylene gas lamp; John Zimmerman, Chicago, Ill.

No. 62,283.—Acetylene gas machine; P. H. Mace, Paris, France.

No. 62,293.—Track clearer; James C. Cameron, Montreal.

No. 62,294.—Acetylene gas generator apparatus; Jean A. Plantin, Ottawa, Ont.

No. 62,312.—Motor vehicle; The Prelot Motor Syndicate, Butolph House, Eastcheap, London, England.

No. 62,336.—Electric engine; Marcy Lelland Whitfield, Chicago, Ill.

No. 62,339.—Steel manufacture; Thos. J. Heskett, 50 North Terrace, Adelaide, South Australia.

No. 62,341.—Steam boiler furnace; Geo. N. Robinson, Brooklyn, N.Y.

No. 62,356.—Flat-railed railway; H. L. Stillman, Charlestown, Rhode Island.

No. 62,359.—Car coupler; Philip Hien, Chicago, Ill.

No. 62,361.—Brake shoe; A. J. Allen, Chicago, Ill.

No. 62,377.—Telephone; R. W. Wallace, 21 De Vere Gardens, Kensington, London, England.

No. 62,378.—Furnace grate; Henry Truesdell, Toronto.

No. 62,385.—Heater and radiator; Chas. Ellingsen, Ashby, Minn., U.S.A.

No. 62,389.—Instrument for determining the amount of elongation and compression of railway rails under moving trains; P. H. Dudley, New York, N.Y.

No. 62,390.—Electric track circuit rail joint; Wm. H. Talley, Waco, Texas.

No. 62,392.—Heater; John A. Markle, Birtle, Man.

No. 62,410.—Compound steam engine; Jos. Hardell, Stratford, Ont.

No. 62,416.—Car pushing device; Wm. L. Joy, Toronto.

No. 62,424.—Boiler; Calixte Cauchene, St. Gabriel de Brandon, Que.

No. 62,440.—Telephone number and address: Annunciator; Wm. J. Walsh, Hamilton, Ont.

No. 62,447.—Steam boiler and furnace; Wm. Hopkins, Dubuque, Iowa.

No. 62,449.—Electric railway truck; Geo. J. Capewell, Hartford, Conn.

No. 62,450.—Gas generating process; Samuel H. Wood, Wilmette, Ill.

No. 62,451.—Steam boiler; David Fitzgibbons, Oswego, N.Y.

No. 62,453.—Steam boiler; N. F. Anderson, Hardid, Ill.

No. 62,455.—Steam boiler; R. Hutchinson, Somerville, Mass.

No. 62,456.—Steam boiler; Geo. H. Watson, Chicago, Ill.

No. 62,457.—Boiler; R. W. Innes, Omaha, Neb.,

No. 62,458.—Steam generator; Henry Hening, Paterson, New Jersey.

No. 62,463.—Acetylene gas lamp; Geo. D. Pearson, Montreal, Quebec.

No. 62,464.—Acetylene generator; F. Cortez Wilson, Chicago, Ill.

No. 62,466.—Process of, and apparatus for, the manufacture of metallic carbides.

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Village of Hintonburgh.

TENDERS FOR WATERWORKS

Tenders for constructing a system of waterworks for the Village of Hintonburgh, sealed, and endorsed "Tenders for Waterworks," will be received until noon of Saturday, 15th April, 1899, addressed to W. A. Mason, Esq., Village Clerk, Hintonburgh, Ontario.

Each tender must be accompanied with an accepted bank cheque for an amount equal to five per cent. of the amount tendered and made payable to the order of W. A. Mason, Treasurer of the Corporation, which cheque will be forfeited if the contractor declines to enter into a contract when called upon to do so.

The Corporation reserves the right to reject any or all tenders.

Plans and specifications can be seen, and printed specifications and forms of tender obtained at the office of the Clerk, Town Hall, Hintonburgh.

Dated at Hintonburgh this 23rd day of March, 1899.

(Signed) D. H. McLEAN, Reeve.

(Signed) CHARLES H. KEEFER, Consulting Engineer, Ottawa.